

For New Technology Network



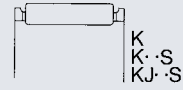
NTNcorporation

# Needle Roller Bearings

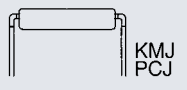


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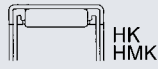
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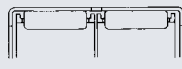
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KJ·S



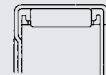
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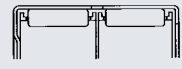
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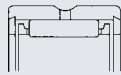
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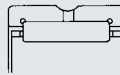
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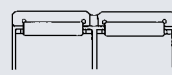
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NK



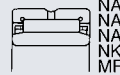
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NK·R  
MR



RNA69



NA49  
NK+IR



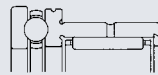
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MR+MI



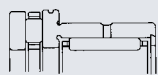
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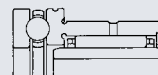
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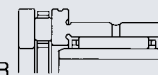
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NKX·Z



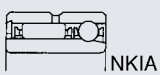
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NKXR



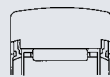
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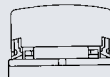
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NKXR·Z+IR



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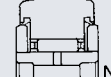
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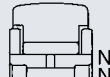
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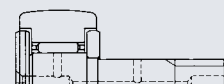
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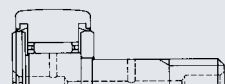
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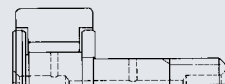
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NACV



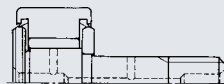
KR



KR·LL



KRV  
CRV



KRV·LL  
CRV·LL



AXK11



K811  
K812



K893



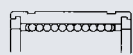
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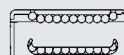
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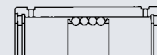
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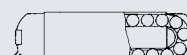
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KH



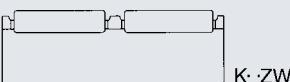
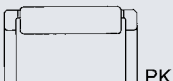
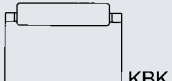
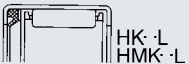
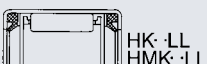
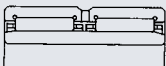
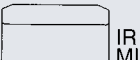
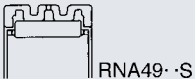
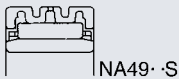
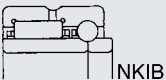
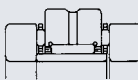
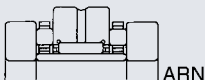
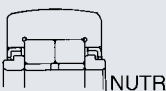
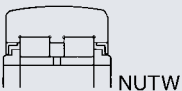
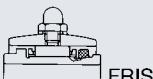
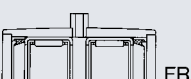
KD



RLM



FF

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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.

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

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

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.

**NTN**

**Needle Roller Bearings**

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## 1. Classification and Characteristics Bearings

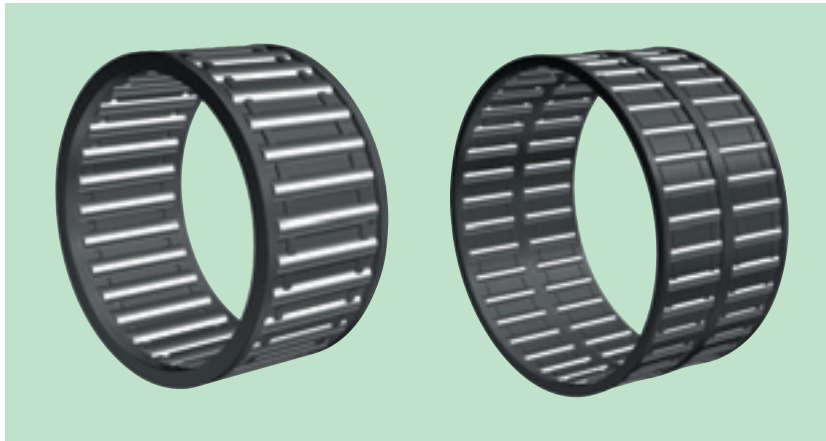
Needle roller bearings have relatively smaller diameter cylindrical rolling elements whose length is much larger than their diameter.

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 force action on them is limited, they are ideal choice for oscillating motion. Needle roller bearings contribute to compact and lightweight machine designs. They serve also as a ready replacement for sliding bearings.

NTN offers the following types of needle roller bearings.

### Needle roller and cage assembly



This assembly, a major component of a needle roller bearing, comprises needle rollers and a cage to support the rollers.

- Using the shaft and housing as raceway surfaces reduces the cross-sectional height: it is equal to the diameter of the needle roller bearing.
- This structure eliminating the outer and inner rings allows the bearing to be fitted more easily.
- The assembly is available in both single-row and double-row configurations.
- As long as the tolerance limit of the shaft and housing is satisfied, the radial internal clearance can be made adjustable.

### Needle roller and cage assembly for connecting rods

This assembly, a major component of a needle roller bearing, comprising needle rollers and a cage to support the rollers, is used typically for connecting rods in reciprocating compressors and small- and mid-sized internal combustion engines such as those for motorbikes, light cars, outboard motors and versatile engines. This assembly features such a cage that is specifically optimized for severe operating conditions involving high impact loads, complicated motions, high-speed revolution and/or high operating temperatures.

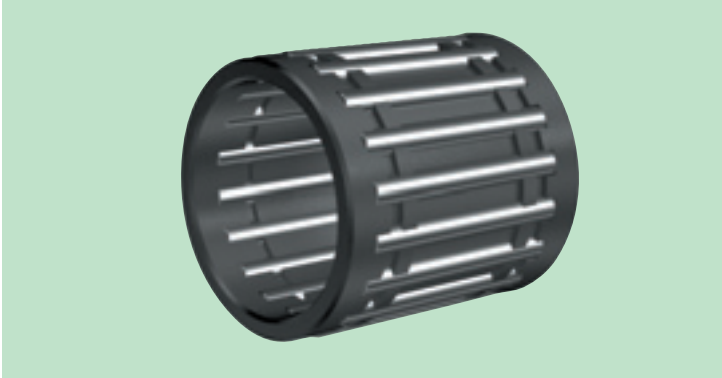
### Needle roller and cage assembly for large end



- This assembly, subjected to a cranking motion with a simultaneous action of the rolling elements' rotation and revolution, must be light but have a high rigidity, and must have a precise dimension of the outer diameter of the cage so that the guiding system can keep an appropriate gap.
- The cage is made of high-tensile special steel with a surface hardening treatment.
- The guiding system employed is an outer diameter guiding system.
- The cage that may be subjected to poor lubrication can be protected with a surface treatment using a non-ferrous metal.
- For applications with a one-piece structure of crank shaft, the cage of split type is also available.

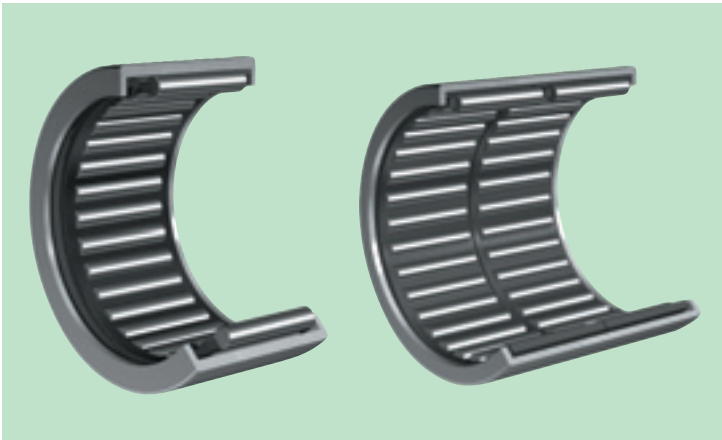


## Needle roller and cage assembly for small end



- Strong impact load acts on this bearing and it oscillates at high speed. Therefore, the cage bore surface is finished with high precision so as to secure lightweight, high rigidity and proper guide clearance.
- The cage is made of high tensile special steel and its surface is hardened ideally.
- The cage is of bore guide type and the guide surface is designed as long as possible to thereby reduce the surface pressure.
- The roller length is designed to the possible maximum value against the connecting width and a number of small-size needle rollers are fitted in the cage to minimize the contact pressure.

## Drawn-cup needle roller bearing



This bearing comprises an outer ring and needle rollers, which were both drawn from special thin steel plate by precision deep drawing, and a cage intended to guide precisely the needle rollers.

- This bearing is the type of the lowest section height, of the rolling bearings with outer ring, best-suited to space-saving design.
- A hardened and ground shaft or inner ring (IR Series) is used as the raceway.
- This bearing needs no axial locking due to easy installation and press-fit in the housing.
- The close end type to close shaft end is available in addition to the open end type.
- Furthermore, the type with seal fitted in at single side or double sides is also available.
- The standard type comprises a needle roller and cage assembly. In addition to this type, special type comprising full complement rollers is available at option.

## Machined-ring needle roller bearings

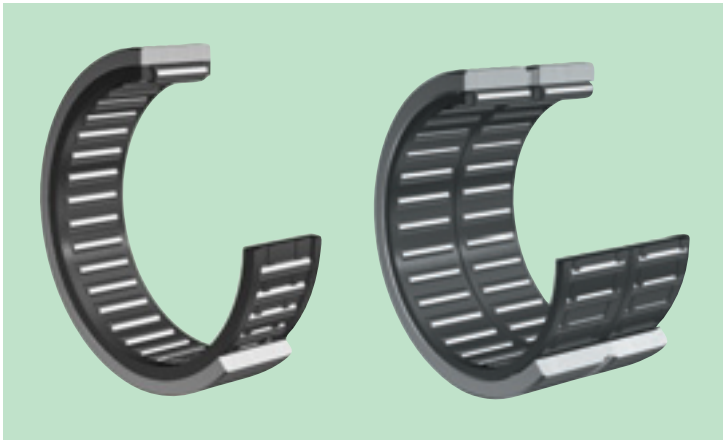


This bearing type comprises a machined outer ring and machined needle rollers, and a cage to guide properly the needle rollers.

In the case of this bearing, the cage or the needle rollers are guided by the ribs of the outer ring or the face ring. Hence, this bearing is non-separable type. In addition, the type with no inner ring is also available for enabling a shaft to be used as the raceway surface. (Of course, the type with inner ring is available.)

- Selectively available for both of the metric system and the inch system.
- Best-suited to space-saving design due to its low section height, then having the large load capacity.
- High rigidity and high bearing accuracy due to its machined (precut) outer ring
- can be used with a housing made of light metal, etc. due to its outer ring of high rigidity.
- Outer ring with lubrication hole and lubrication groove
- Single row and double row types available.
- The type with seal fitted in at single side or double sides is also available.

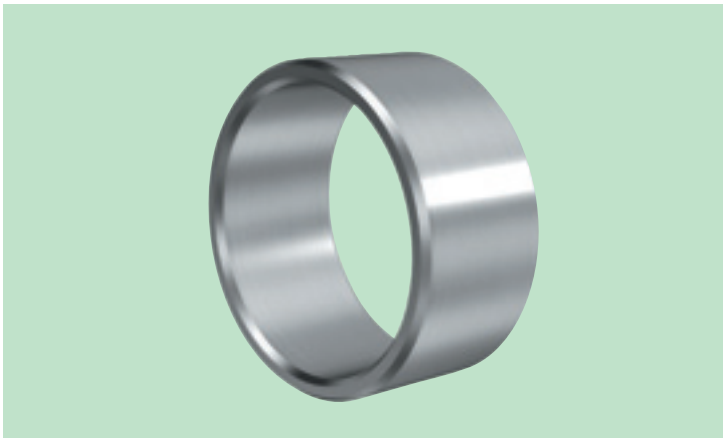
## Machined-ring needle roller bearing separable type



This bearing type comprises a machined outer ring and machined needle rollers, and a cage to guide and retain properly the needle rollers. And the needle roller and cage assembly is separable from the outer ring. In addition to the standard type, the type with no inner ring is also available for enabling a shaft to be used as direct raceway surface. (Of course, the type with inner ring available, too.)

- Easy to install, — the needle roller and cage assembly, the outer ring, and the inner ring can be mounted independently from each other.
- Any optional radial internal clearance is selectable by combining the individual independent components.
- Best-suited to space-saving design due to its low section height, then having the large load capacity.
- High rigidity and high bearing accuracy due to its machined (precut) outer ring.
- Can be used with a housing made of light metal, etc. due to its outer ring of high rigidity.
- Single row and double row types available. And the outer ring of the double row bearing is provided with lubrication hole and lubrication groove.

## Inner ring



For the needle roller bearings, usually a shaft is used as the raceway surface, but this inner ring is used where the shaft surface can not be machined to the specific hardness and roughness. This inner ring is suited to space-saving design due to its low section height. This is made of high carbon chrome bearing steel, finished by high precision grinding after heat-treated.

- Can also be used as a bush.
- Selectively available for both of the metric system and the inch system.
- The type with lubrication hole at the raceway center also available.

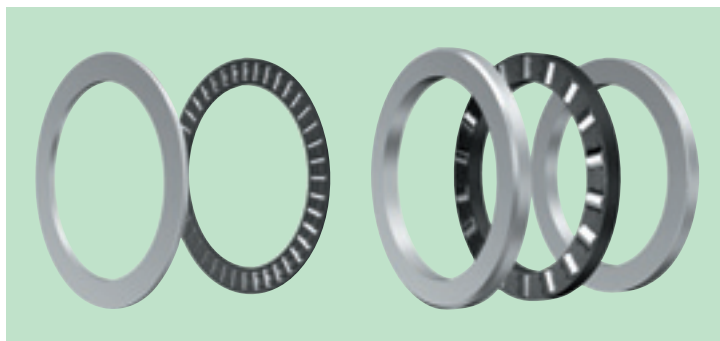
## Clearance-adjustable needle roller bearing



This bearing type comprises a machined outer ring and machined needle rollers, and a cage to guide and retain properly the needle rollers, but the needle roller and cage assembly is non-separable from the outer ring. In addition to the standard type, the type with no inner ring is also available for enabling a shaft to be used as direct raceway surface. (Of course, the type with inner ring available, too.)

- The raceway diameter of the outer ring is shrunk by pressing the outer ring in axial direction, which then enables to reduce the roller set bore diameter correspondingly.
- Radial clearance is finely adjustable by adjusting axial pressing load and thereby changing shrinkage of the outer ring raceway diameter.
- This bearing is applied to the work spindle of a machine tool and other similar portions which require the high speed rotational accuracy of JIS Grade-4.

## Thrust roller bearing



This bearing comprises needle rollers or cylindrical rollers, a cage to guide and retain properly the rollers, and disc-shaped rolling bearing ring. This is a bearing capable of supporting one-way axial load. Furthermore, this bearing can be used without rolling bearing ring, where the heat-treated and ground bearing mount surface can be used as the raceway surface.

- Best-suited to space-saving design due to its small section height, then having the large load capacity.
- Available are AS type rolling bearing ring made of thin steel plate with hardened surface and WS type and GS type machined rings.

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



This complex bearing comprises a radial needle roller bearing for supporting radial load and a thrust bearing for supporting axial load which are assembled integrally. Both thrust ball bearing type and thrust axial roller bearing type are available as the bearing intended to support axial load.

- The thrust bearing with dust-proof cover is also available, which has a good effect in preventing scattering of oil and grease and invasion of external dust, etc.

## Complex needle roller bearings

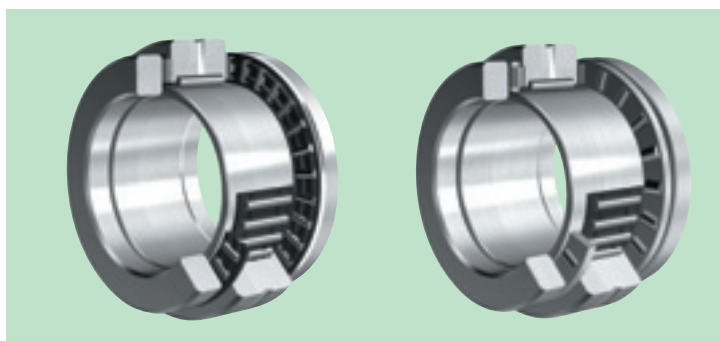
### — Needle roller bearing with angular ball bearing, needle roller bearing with three-point contact ball bearing —



This complex bearing comprises a radial needle roller bearing for supporting radial load, a ball bearing for supporting comparatively small axial load and a machined inner ring which are all assembled integrally. Both angular ball bearing and three-point contact ball bearing are available as the ball bearing intended to support axial load.

- The complex needle roller bearings (NKIA Series) using an angular ball bearing as the thrust bearing can support one-directional angular load.
- The complex needle roller bearings (NKIB Series) using a three-point contact ball bearing as the thrust bearing can support double-directional axial load and furthermore its position in axial direction can be fixed, too.

## Needle roller bearing with double thrust roller bearing



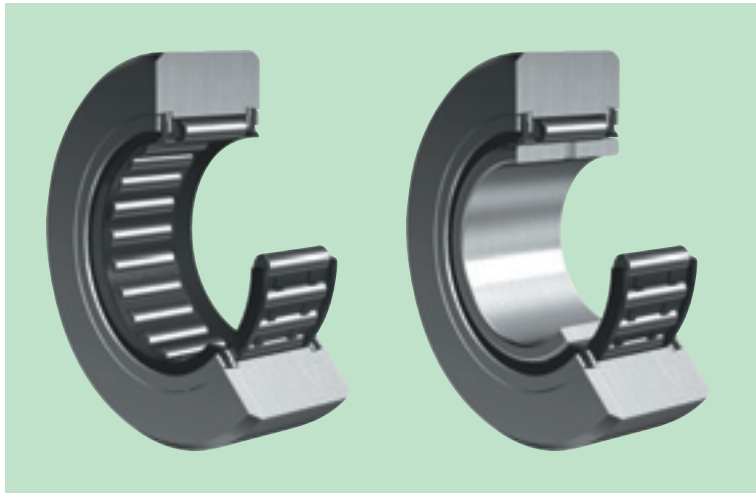
This is a complex bearing wherein a thrust needle roller bearing or a thrust cylindrical roller bearing intended to support axial load is configured at the double sides of a radial needle roller bearing for supporting radial load.

- Can support large axial load acting thereon from the double sides.
- Used as the bearing (precision bearing) for supporting the ball screw of a machine tool.

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

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

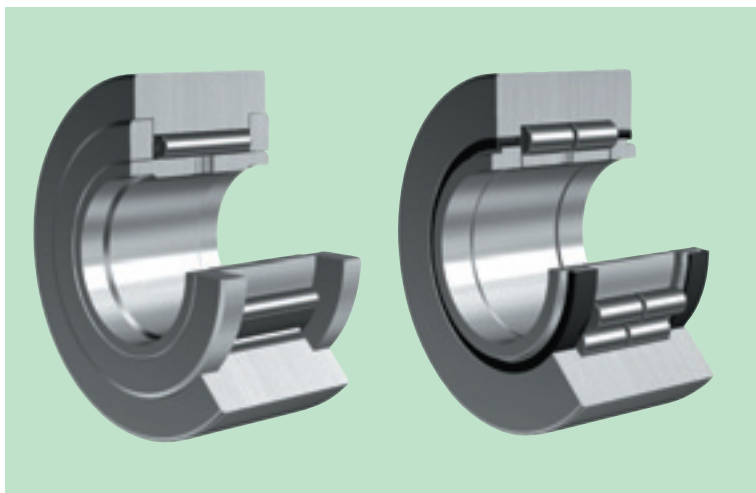
## Roller follower — Without axial guide —



This roller follower is a bearing designed for rotation of the outer ring wherein a needle roller and cage assembly and a synthetic rubber seal reinforced with steel plate are assembled in the 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.
- The shaft must be provided with a thrust washer and a flange, because of the outer ring with no ribs (or face ring) and no axial guide function.
- The outer surface is available in both spherical (crowning) profile and cylindrical profile.
- The bearing with spherical outer ring is effective in damping bias load which is caused by deviation in installing.
- The bearing with cylindrical outer ring is suitable to the 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 —



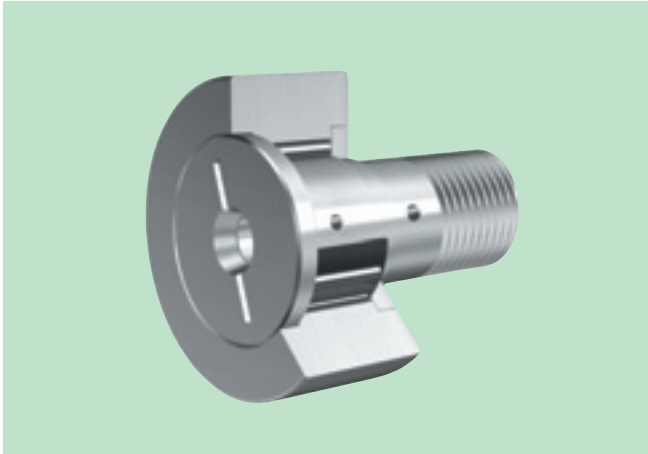
This roller follower is a bearing designed for rotation of the outer ring wherein a needle roller and cage assembly, an inner ring, and a face ring are assembled in the thick-walled outer ring.

This bearing uses needle rollers as its rolling element and furthermore classified into bearing with cage and 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 bearing with spherical outer ring is effective in damping bias load which is caused by deviation in installing.
- The bearing with cylindrical outer ring is suitable to the 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).



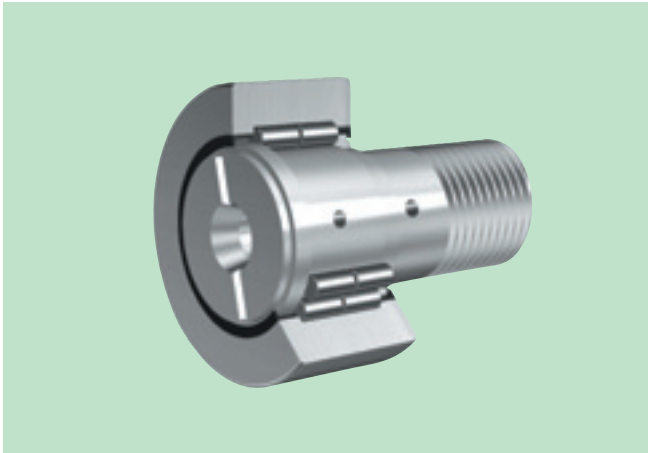
## Cam follower — Needle roller type —



This is a bearing designed for rotation of the outer ring in which a needle roller and cage assembly and a stud in lieu of inner ring are fitted in the thick-walled outer ring. The stud is so threaded as to be mounted easily. This cam follower (bearing) uses needle rollers as its rolling element and it is further classified into one bearing type with cage and another 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.
- The full complement roller type enabling to use more needle rollers than the type with cage has large load capacity.
- The outer surface is available in both spherical (crowning) profile and cylindrical profile.
- This cam follower (bearing) is selectively available for both of the metric system and the inch system.
- Furthermore, the seal built-in type is also available.
- The stud is of either recessed head type allowing use of a screwdriver or hexagon socket head type so as to be mounted and adjusted easily.

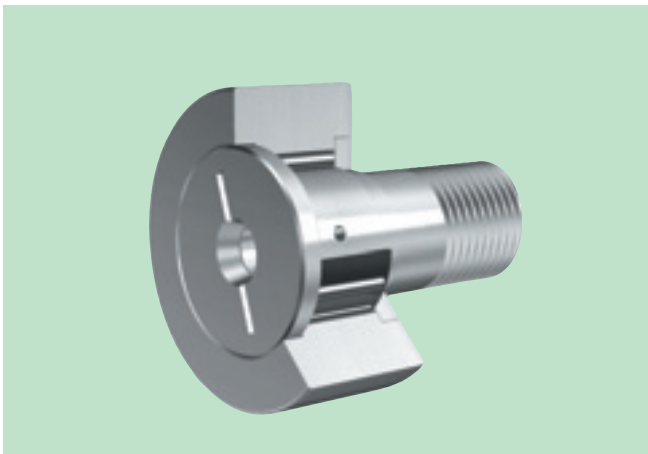
## Cam follower — Cylindrical roller type —



This is a full complement roller bearing designed for rotation of the outer ring in which double-row cylindrical rollers and a stud in lieu of inner ring are fitted in the thick-walled outer ring. The stud is so threaded as to be mounted easily.

- This cam follower (bearing) has the radial /axial load capacity larger than the needle roller type.
- 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 of either recessed head type allowing use of a screwdriver or of hexagon socket head type so as to be mounted and adjusted easily.

## Cam follower — Eccentric type —



This is a cam follower (bearing) wherein the studs of the needle roller type and cylindrical roller type prescribed above were made eccentric, which 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 of either recessed head type allowing use of a screwdriver or hexagon socket head type so as to be mounted and adjusted easily.

The components described hereunder are for needle roller bearing.

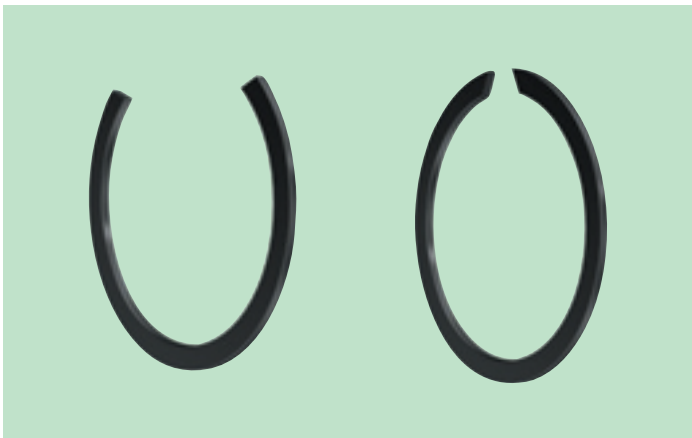
## Needle rollers



The needle rollers with flat end face and round end face are standard. These rollers are made of high-carbon chrome bearing steel, surface-finished by grinding and buffing after heat-treated. The standard accuracy of these rollers is "Precision Grade".

- A-Inter-diameter tolerance of the needle rollers is 2mm maximum.
- The roller type with crowned rolling surface is also available, which can damp edge load.
- These needle rollers are supplied as an individual for applications (pin, shaft) other than rolling element.

## Snap rings



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

The ring material is a hard steel wire rod and chemical conversion treatment is applied to its surface so as to provide high rigidity.

- Two types are available for shaft and housing use.
- The section height is lowered flexibly according to the dimensions of needle roller bearings. In addition, manufacture of these rings is available up to the possible minimum dimensional range.
- For the axial guide it is recommended to provide a spacer between the cage and the snap ring.

## Seals



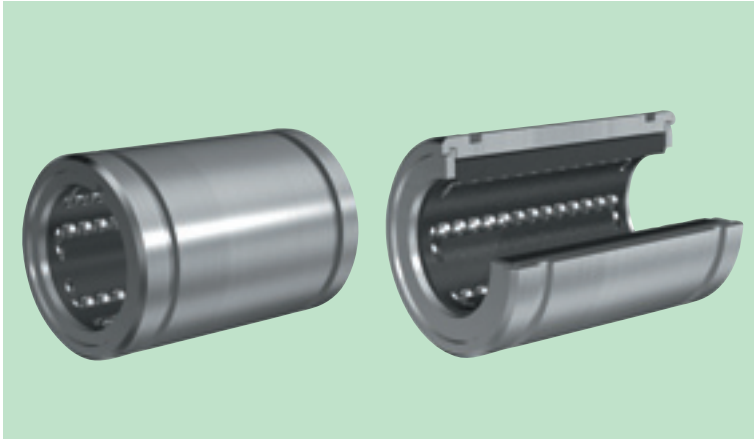
This is a special-purposed seal which was designed so as to match the small section height of needle roller bearings.

- G-type seal with one lip and GD-type seal with two lips are selectively available on application.
- These seals comprising steel ring and synthetic rubber can be used at the operating temperature ranging from -25 to 120°C, but continuous use thereof is subject to 100°C and less.
- These seals act to prevent invasion of external foreign matter and over-consumption of lubrication grease.
- The radial section height of each seal is designed so as 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.

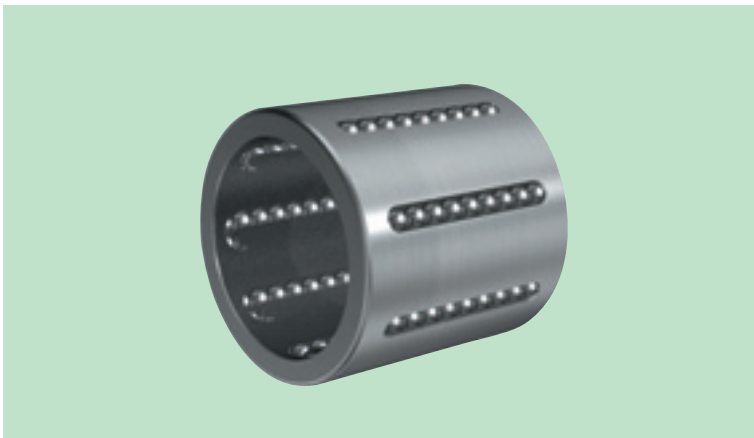
## Linear ball bearing — Machined ring type —



This is a high precision bearing which comprises a machined outer ring and face ring, steel balls and a synthetic resin cage for retaining the balls and rolls on a shaft, maintaining the endless linear motion.

- 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 therein.
- The steel balls are guided precisely by the cage so that stable linear motion can be achieved with less friction resistance.
- No rotational motion is available.

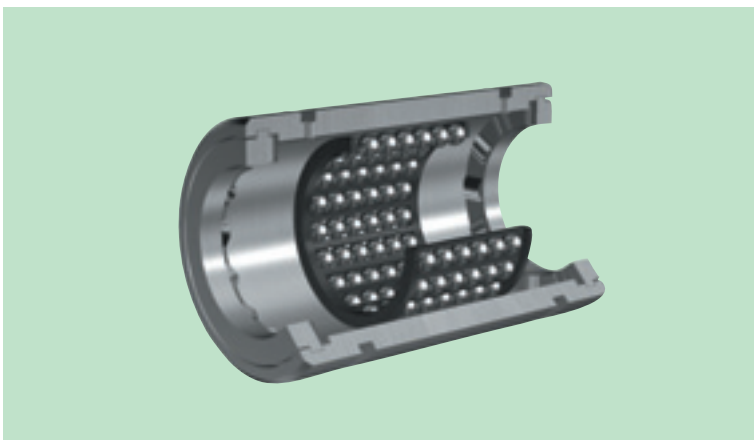
## Linear ball bearing — Drawn cup type —



This is a high precision bearing which comprises an outer ring drawn from thin special steel plate by precision deep drawing, steel balls and a synthetic resin cage for retaining the balls and rolls on a shaft, maintaining the endless linear motion.

- The outer ring made of thin steel plate enables to make less the section height and to design the linear motion system of compact structure.
- 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.

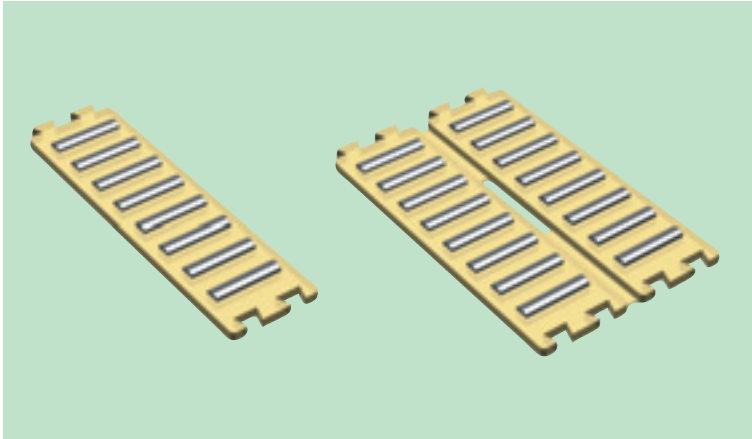
## Linear ball bearing — Stroking type —



This bearing comprises a machined outer ring and face ring, steel balls and a cage for retaining the balls and reciprocates finitely on a shaft as well as rotates on a shaft. The outer ring is provided with a snap ring as the cage stopper at its double sides and, furthermore, a wavy spring is provided between the snap ring and the cage to damp impact acting the cage and to thereby prevent wear of the cage.

- Some bearings of this stroking type are provided with a synthetic rubber seal at its double sides to prevent invasion of foreign matter therein.
- The outer ring is so grooved that snap ring can be fitted and fixed easily.

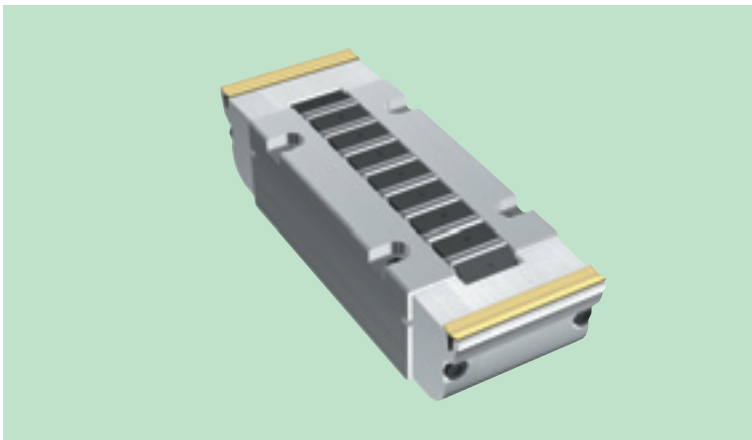
## Linear flat roller



This is a flat roller bearing which comprises a flat cage and needle rollers and reciprocates on a flat raceway in linear direction by motion of its linear movable components.

- The molded polyamide resin cage and press-formed steel plate cage are selectively available on application.
- FF type molded resin cage — Several cages can be used with them jointed with each other in parallel configuration.
- The press-formed steel plate cage — Cage to cage jointing is unavailable, but it can be supplied at any optional length.
- In the case of double-row resin cage, it is provided with an elastic joint at its center part so it can be reformed at any optional angle by dipping it in an oil of 70 to 90°C and can be mounted on a Vee-grooved surface.

## Linear roller bearing

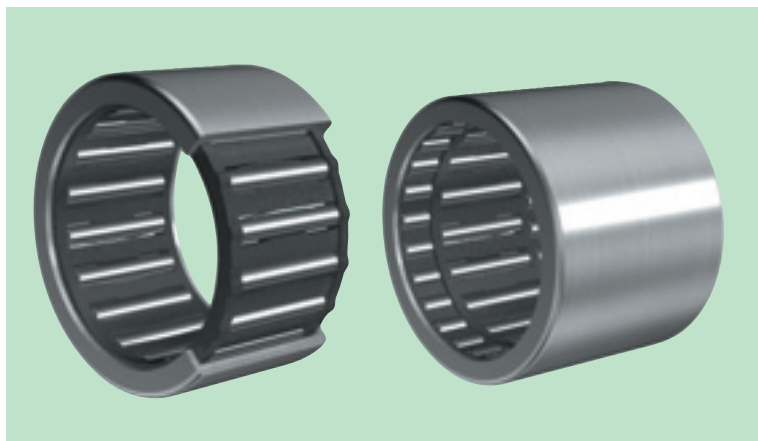


This bearing comprising cylindrical rollers capable of turning internally around the track frame moves endlessly on a flat surface in linear direction.

- Low friction factor due to the case assemblies preventing neighboring roller from touching.
- High load rating due to use of cylindrical rollers.

This catalogue describes the following products, too.

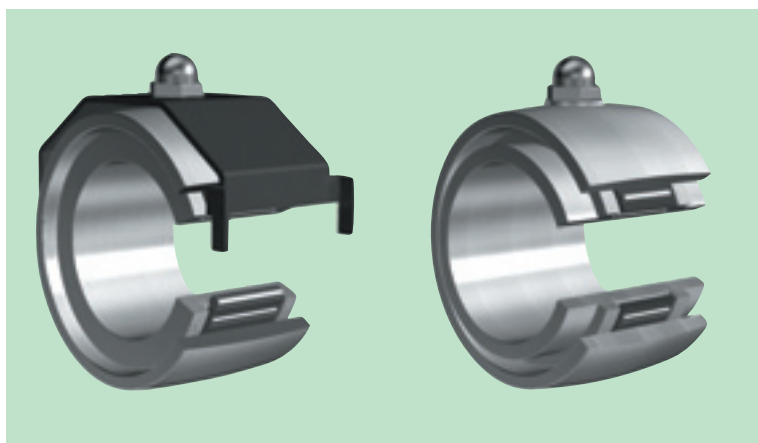
## One-way clutch



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

- Less friction torque against over-running, great transmission torque for small section height.
- Various types are available as follows; one-way clutch with bearing built therein to support radial load, one-way clutch with outer ring plated for improvement of erosion resistance, one-way clutch integrated with gear, pulley, etc.
- HF type and HFL type can be locked axially by being only press-fitted in the housing.
- These one-way clutches use the outer ring drawn by precision deep drawing, which needs the housing with wall thickness of a specified value or more.
- HF type is subjected to configuration of a radial ball bearing at its double ends. (On the other hand, HFL type is complete with radial bearings built-in at its double sides.)

## Bottom roller bearing — For textile machinery —



This is a grease pre-filled needle roller bearing intended to support the bottom rollers. The spherical outer surface of the outer ring can allow bottom roller mounting error to some extent. On the other hand, the inner ring is provided with ribs at its double ends. A clearance between the outer ring ribs and the inner ring ribs is kept less and, in addition, the outer surface of each inner ring rib is knurled so as not to allow easy invasion of mist, etc. into the bearing.

## Tension Pulley — For Textile Machinery —



This pulley is used to guide the tapered portion or belt of the spindle drive unit in each of a fine spinning machine, a rough spinning machine, a pre-twisting machine, etc. as well as to apply tension to them. The pulley drawn from steel plate by precision deep drawing is press-fitted on the outer ring of shaft bearing instead of inner ring.

## 2. Load Rating and Life

### 2.1 Bearing life

Even when bearings are in running under normal condition, the raceway surface and the surfaces of the rolling elements inevitably subjected to repetitive compression stress result in flaking due to fatigue of the raceway an element materials and can resist no longer to further running even under normal condition. "Bearing life" is defined as the total cumulative bearing revolutions until flaking occurs thus on the raceway surface or the element rolling surfaces.

Further use of bearings becomes unavailable, caused by various defects such as seizure, wear, crack, chipping, chattering, rusting, etc. in addition to the flaking phenomenon stated above. However, these phenomena should be deemed as defects of bearing itself and, therefore, be discriminated from bearing life. And the defect causes are such as incorrect selection of bearing, improper mounting, improper lubrication, imperfect sealing, etc. Hence, bearing trouble can be avoided by removing the said causes.

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

Even when a group of same bearings have been in running under the same condition, considerably great variation is found among the individual bearing lives. This comes from variation in material fatigue itself. Hence, the basic rated life defined below considering statistically this variation in material fatigue is applied as the bearing life.

The basic rated life means the substantial total cumulative revolutions of the individual bearings 90% (90% reliability) of which can revolve without resulting in flaking due to rolling fatigue when a group of same bearings have been put individually in continuous running under same condition. When bearings have been in running in constant revolution, the basic rated life is expressed as the total cumulative revolutions of the individual bearings.

On the other hand, the basic dynamic load rating represents the load capacity of rolling bearing, then meaning a constant load under which the basic rated life of 1,000,000 revolutions is achieved. This constant load of radial bearing is expressed with net radial load, while that of thrust bearing is expressed with net axial load.

The bearing dimensions table in this catalogue describes the respective basic dynamic load ratings of the bearings that were manufactured using NTN's standard materials and manufacturing processes in current use.

For the respective basic rated lives of the bearings manufactured using the special materials and special manufacturing processes, feel free to contact NTN for inquiry.

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

Basic Rated Life specified in ISO 281.

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

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 determined by **formula (2.2)**, where it is expressed in the operating hours.

$$L_{10h} = 500 f_n^p \quad \text{.....(2.2)}$$

$$f_n = f_n \frac{C}{P} \quad \text{.....(2.3)}$$

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

where,

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

$f_n$  : Life factor

$f_n$  : Speed factor

$n$  : Rotational speed, r/min

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

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

Considering the life of either one, of several bearings installed in a machine or an equipment, until it breaks down due to rolling fatigue as the total bearing life as a whole, it can be determined by **formula (2.6)**.

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

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 Bearing-applied machines and requisite life

In selecting a bearing, it is essential to set up the requisite life of the bearing under the intended operating conditions, but the requisite life is mainly determined by the durability period and in-running reliability required for a machine to which the bearing is applied. In general, the requisite lifetime as a guideline is as shown in **Table 2.1**.

The fatigue life of bearing is an important factor to decide the bearing size to be applied. In addition to this factor, however, the strengths and rigidities of shaft and housing must be taken into consideration.

**Table 2.1 Operating conditions and requisite lifetime**

| Operating conditions                                                                                                                                                                                                                                                                                                                                                             | Lifetime $L_{10h}$ |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| Tools and devices requiring no all-time running<br>Ex.) Door switcher, etc.                                                                                                                                                                                                                                                                                                      | 500                |
| Machines which are operated for a short time or intermittently and do not cause comparatively great affect on others even if they shut down incidentally due to trouble.<br>Ex.) Hand tools, heavy material handling hoist in a machining shop, general hand-operated machines, agricultural machines, crane in a casting shop, material automatic feeder, home appliances, etc. | 4 000 ~ 8 000      |
| Machines which are not put in continuous running but required to run very precisely<br>Ex.) Auxiliary machines in a power station, conveyor in a flow process, elevator, general cargo handling crane, machine tool of low frequency in use, etc.                                                                                                                                | 8 000 ~ 14 000     |
| Machines which are operated for 8 hours per day but not put in all-time continuous running<br>Ex.) Power generator in a factory, general geared unit, etc.                                                                                                                                                                                                                       | 14 000 ~ 20 000    |
| Machines which are operated for 8 hours per day<br>Ex.) General machines in a machining shop, crane in all-time operation.                                                                                                                                                                                                                                                       | 20 000 ~ 30 000    |
| Machines which are put in 24-hour continuous running<br>Ex.) Separator, compressor, pump, main shaft, table roller of rolling mill, conveyor roller, winding engine in a mine, driving motor in a factory, etc.                                                                                                                                                                  | 50 000 ~ 60 000    |
| Machines which are put in 24-hour continuous running and, in addition, are not allowed absolutely trouble shutdown.<br>Ex.) Cellulose manufacturing machine, paper making machine, power station, drainage pump in a mine, urban city water related equipment, etc.                                                                                                              | 100 000 ~ 200 000  |

## 2.4 Bearing life using the adjusted life rating factor

The basic bearing life rating (90% reliability) can be calculated using the formulas prescribed in Subsection 2.2, but on occasion the bearing life of over-90% reliability must be determined on application. Also, the bearing life can be further extended by using a specially improved bearing material and special manufacturing process/technique. Furthermore, it was clarified by the elastohydrodynamic lubrication theory that the bearing life would be influenced by bearing operating conditions (lubrication, temperature, speed, etc.)

The bearing life considering the above factors can be determined by **formula (2.7)** using "Life Adjustment Factor" specified in ISO 281.

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

where,

- $L_{na}$  : Adjusted life rating  $10^6$  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 values of reliability adjustment factor  $a_1$  for 90% and higher reliability are as shown in **Table 2.2**.

### 2.4.2 Life adjustment factor for bearing material $a_2$

Where bearing material used is special type and quality and manufactured in the special process, the life-related bearing characteristics are inevitably variable depending on the specialties of the material. In such a case, the bearing life is adjusted using the life adjustment factor for bearing material  $a_2$ .

The basic dynamic load ratings described in "Bearing Dimensions Table" are subject to use of the standard

**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                                |

materials and manufacturing processes / techniques being used in NTN, and usually  $a_2=1$  rating is used.

Furthermore,  $a_2>1$  is eventually applied to the bearings manufactured using the specially improved material and manufacturing process / technique. In such a case, feel free to contact NTN for further instruction.

Where bearings made of high carbon chrome bearing steel are used at 120°C and over throughout a long term, the dimension of the normal heat-treated bearing varies significantly and, therefore, dimension-stabilizing heat-treatment (TS treatment) must be done to the bearings according to the maximum operating temperature. However, this dimension-stabilizing treatment causes the bearing hardness to reduce, finally an inverse affect on the bearing life. To avoid it, the bearing life is adjusted (compensated) by multiplying the life rating by the life adjustment factor for bearing material  $a_2$  shown in **Table 2.3**.

**Table 2.3 Values of life adjustment factor for bearing material  $a_2$  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 for adjustment (compensation) of the bearing life, where the lubricated bearing condition gets worse and the lubricant deteriorates or foreign matter is included in the bearing, caused by the rotational speed, temperature rise, etc. of the bearing in running.

Generally the life adjustment factor in the case of good lubricated bearing condition is  $a_3=1$  and, particularly where the lubricated bearing condition is good and other factors for the bearing are normal,  $a_3>1$  can be applied to adjustment of the bearing life. However,  $a_3<1$  is applied in the following cases.

- **Low viscosity of lubrication oil under bearing**

temperature in running

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  $n$  r/min by pitch circle diameter  $d_p$  mm of rolling element is  $d_p \cdot n < 10000$ .)

- **High operating temperature of bearing**

High operating temperature of bearing would cause the raceway hardness to reduce, whereby bearing life would be shortened. In such a case, the bearing life is adjusted (compensated) by multiplying the value shown in **Fig.2.1** as the life adjustment factor for operating conditions depending on operating temperature.

- **Inclusion of foreign matter in lubricant**

In the case of special operating conditions, feel free to contact **NTN** for inquiry. For a bearing manufactured using the specially improved material and manufacturing process/technique, usually  $a_2 \times a_3 < 1$  is applied unless the lubricating condition is good, even though the life adjustment factor is  $a_2 > 1$ .

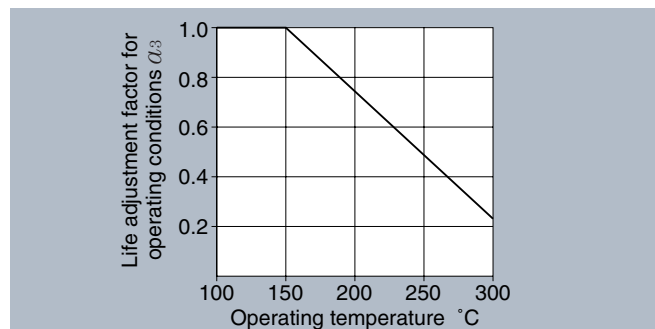


Fig. 2.1 Life adjustment factor for operating conditions depending on operating temperature

### 2.5 Affect on basic dynamic load rating by raceway surface hardness

When a bearing rolls on shaft surface/housing surface as its raceway surface, the surface layer must be hardened to HRC58 to 64 in proper hardening depth.

Ordinary quenching, carburizing or induction quenching, etc. are available as the raceway hardening method, but low hardness of the raceway would cause the bearing fatigue lifetime to reduce. In such a case, the basic load rating is adjusted by multiplying the hardness factor shown in **Fig.2.2**.

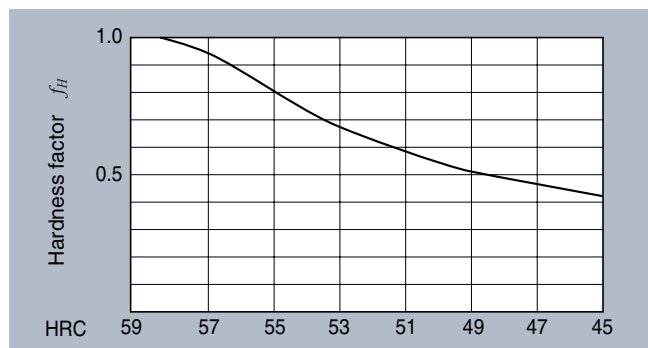


Fig. 2.2 Hardness factor

### 2.6 Life of bearing with oscillating motion

The life of bearing with 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 rating subject to rotational speed r/min identical to oscillation frequency cpm

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

Generally **Fig.2.3** is applied when the oscillation angle exceeds critical angle  $2\beta$ . This critical angle is nearly determined by design of bearing internals —mainly the number of rolling elements included in single row bearing.

Where a bearing with oscillating motion is used at below the critical angle, its life is shorter than the lifetime value calculated using **Fig.2.3**. When the critical angle is unknown, determine  $\Omega$ , assuming  $\beta = \beta_c$ . Feel free to contact **NTN** for inquiry about the critical angle of individual bearings.

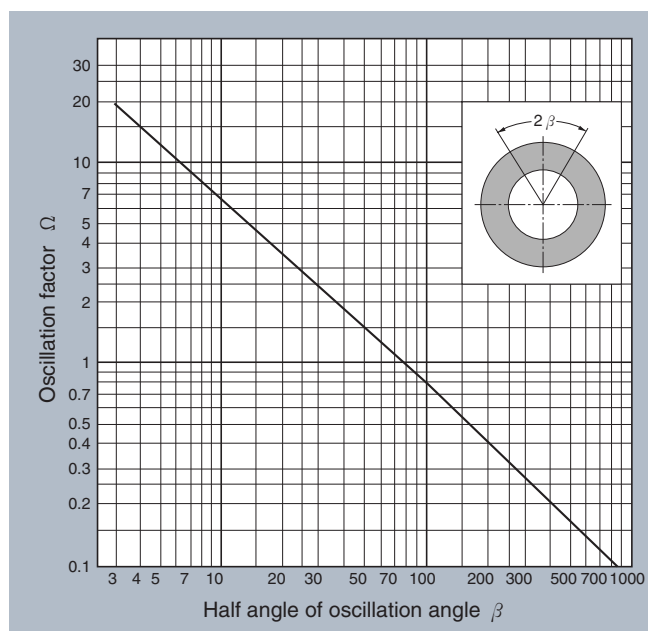


Fig. 2.3 Relationship of oscillation angle  $\beta$  to factor  $\Omega$

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)**.

$$\text{Critical oscillation angle } \theta \geq \frac{360^\circ}{Z} \cdot \frac{d_p}{d_p - D_a \cos \alpha} \dots\dots(2.9)$$

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  $d_p + D_a \cos \alpha$ .)

## 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;

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

When the rolling elements are rollers;

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

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

When the rolling elements are balls;

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

When the rolling elements are rollers;

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

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 N (kgf)

## 2.8 Various factors influencing bearing life

Bearing life is influenced by not only bearing load and rotational speed but also various factors such as lubricating condition, internal clearance, surface roughness and hardness of raceway, heat-treated structure, misalignment, etc. In using bearings, therefore, these influence factors must be taken into full consideration. **Table 2.4** shows the bearing operating conditions as a guideline. (For the detail refer to "Commentary" described in Bearing Dimensions Table every each bearing type.)

**Table 2.4 Guideline of the bearing operating conditions**

|                                    |                                                                                                       |
|------------------------------------|-------------------------------------------------------------------------------------------------------|
| Allowable rotational speed (r/min) | See Dimensions Table                                                                                  |
| Surface roughness of raceway       | within 0.2a                                                                                           |
| Surface hardness of raceway        | HRC58 to 64<br>Note: Refer to Subsection 7.5 for various materials and heat-treated hardness thereof. |
| Misalignment                       | 1/2000 or less (for radial bearing)                                                                   |
| Radial internal clearance          | Ordinary level (C2, C3, C4)                                                                           |

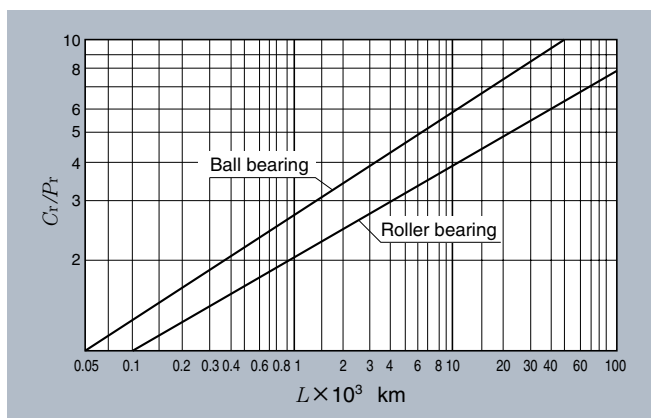


**Fig. 2.4 Life of bearing with axial motion**

## 2.9 Fitting misalignment and crowning

Generally it is well known that stress concentration at edge portion (so called, edge load) arising from fitting misalignment would 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 roller to reduce, which could then lead to shorter life of bearing. It is therefore necessary to calculate a proper crowning value though depending on the extent of fitting misalignment.

And load condition. For reference, **Figs.2.5 to 2.7** show the examples of contact surface pressure analysis by a computer.

As seen from **Figs.2.5 to 2.7** (Examples of contact surface pressure analysis), the rollers with no crowning have high edge surface pressure, while the rollers with crowning restrain the edge surface pressure lower in the range of specific allowable fitting misalignment. **Fig.2.8** shows the relationship of allowable fitting misalignment to bearing lifetime. (example of computer analysis) It is possible to see from this Figure how the bearing lifetime is influenced by fitting misalignment.

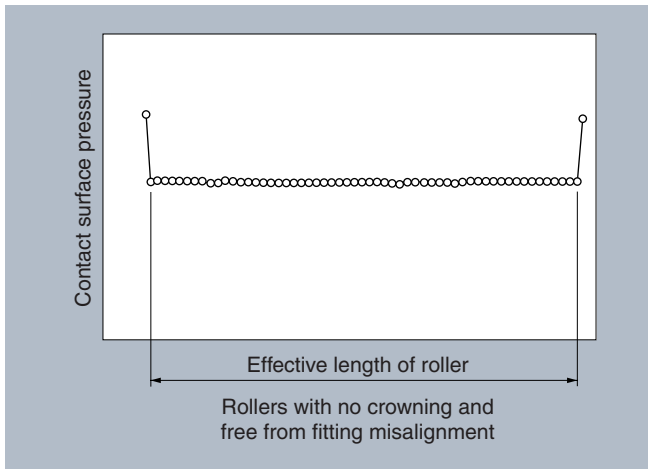


Fig. 2.5

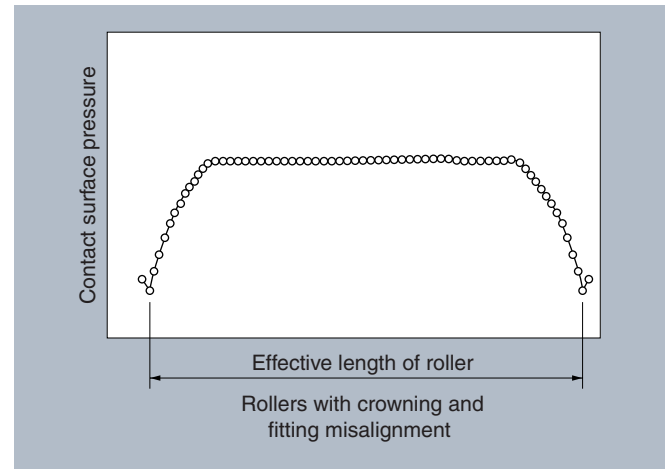


Fig. 2.7

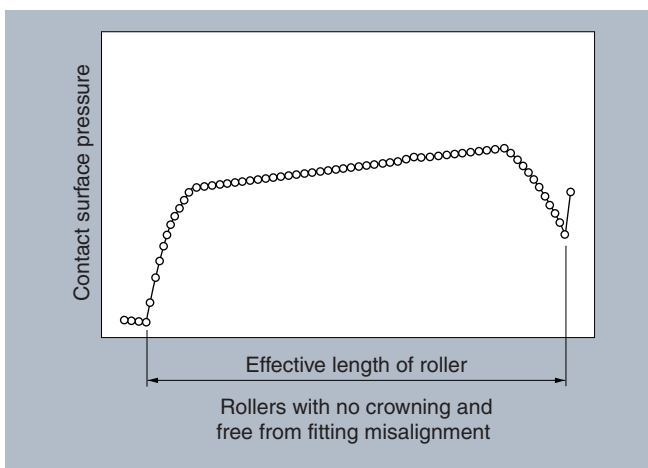


Fig. 2.6

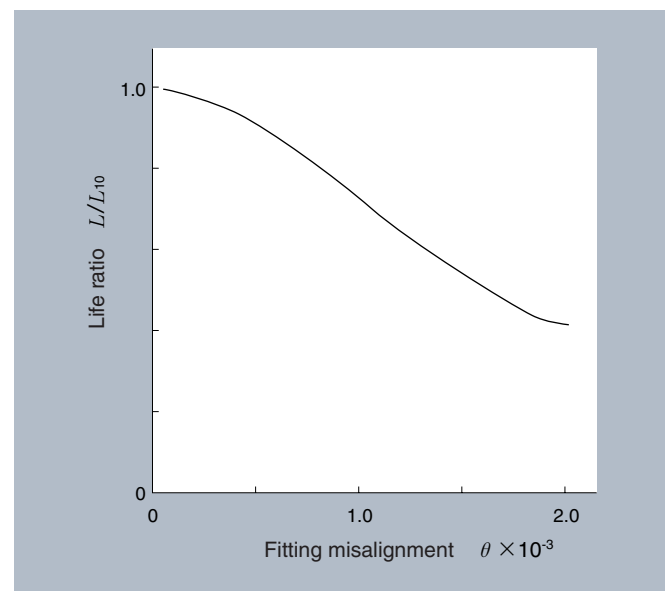


Fig. 2.8 Relationship of fitting misalignment to bearing lifetime

## 2.10 Radial internal clearance, surface roughness and surface hardness, and bearing life

The relationship of radial internal clearance to bearing life is as shown in **Fig. 2.9** and the relationship of surface roughness to bearing life as shown in **Fig.2.10**.

It is possible to see from these Figures how the bearing life is influenced by each factor.

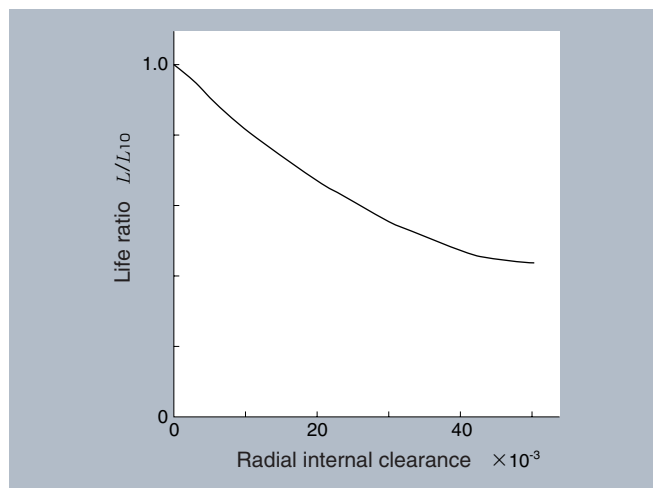


**Fig. 2.9 Relationship of radial internal clearance to bearing life**

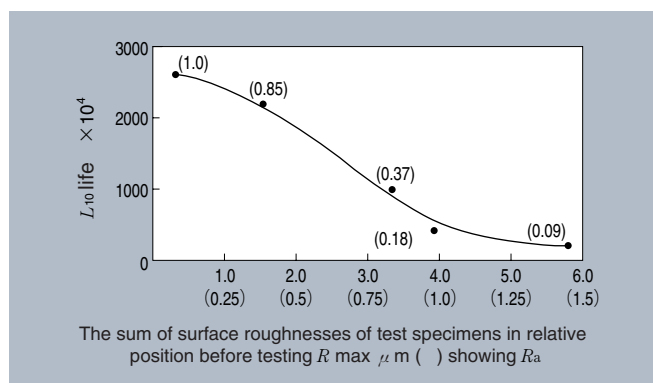


**Fig. 2.10 Relationship of surface roughness to bearing life**

## 2.11 Basic static load rating

Load acting on a bearing, when acted, results in locally permanent deformation of the contract surface of rolling elements to bearing ring. And this deformation value increases inevitably with the increasing load and smooth rotation of the bearing is interfered with by the deformation when it exceeded a certain limit value.

It is known experimentally that the total permanent deformation value 0.0001 times as large as the rolling element diameter at the contact center of rolling elements to raceway both of which are subjected to maximum stress is an allowable deformation limit which does not interfere with smooth rotation of bearing.

"Basic static load rating" is defined as such a constant static load that results in permanent deformation of the said limit value, which is then expressed in net radial load for radial bearings and in net axial load for thrust bearings.

Regarding this load value, each table of bearing dimensions describes it in the  $C_{or}$  field for radial bearings and in  $C_{oa}$  field for thrust bearings respectively.

When the load defined above acts on a bearing, contact stress at the contact center of rolling element to raceway, which are subjected to maximum load, reaches the following value.

For roller bearing .....4000MPa (408kgf/mm<sup>2</sup>)  
For ball bearing .....4200MPa (428kgf/mm<sup>2</sup>)

## 2.12 Allowable static bearing load

The basic static load rating prescribed in Subsection 2.11 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  $S_0$  in the following **formula (2.14)** and **Table 2.5**.

$$S_0 = C_0 / P_0 \text{ .....(2.14)}$$

where,

$S_0$  : Safety factor

$C_0$  : Basic static rated load, N (kgf)

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

For thrust bearings:  $C_{oa}$ )

$P_{0 \max}$  : Maximum static bearing load, N (kgf)

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

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

**Table 2.5 Lower limit value of safety factor  $S_0$**

| 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. For the drawn-cup needle roller bearings, 3 shall be adopted as  $S_0$  lower limit value.  
2. Where vibration and shock load act on bearing,  $P_{0 \max}$  shall be determined considering the shock load factor.

## 3. Calculation of Bearing Loads

### 3.1 Load acting on shafts

The loads acting on the shaft to be supported with the bearing must be determined for calculation of bearing loads. These loads include the self-weight of rotor assy, loads inevitably resulting from a machine in running, loads arising from power transmission, etc. These loads are mostly difficult to calculate though some of them can be calculated numerically and theoretically.

The following paragraphs describe how to calculate the loads acting on a power transmission shaft as one of the main bearing applications.

#### 3.1.1 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. For calculation of the loads acting on other gears, feel free to contact NTN for inquiry.

##### (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 (3.1) to (3.4)**.

$$K_t = \frac{19.1 \times 10^6 \cdot HP}{D_p \cdot n} \left( \frac{1.95 \times 10^6 \cdot HP}{D_p \cdot n} \right) \dots\dots\dots (3.1)$$

$$K_s = K_t \cdot \tan \alpha \text{ (Spur gear)} \dots\dots\dots (3.2a)$$

$$= K_t \cdot \frac{\tan \alpha}{\cos \beta} \text{ (for helical gear)} \dots\dots\dots (3.2b)$$

$$K_r = \sqrt{K_t^2 + K_s^2} \dots\dots\dots (3.3a)$$

$$K_a = K_t \cdot \tan \beta \text{ (for helical gear)} \dots\dots\dots (3.4)$$

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)
- $HP$  : Transmission power kw
- $n$  : Rotational speed r/min
- $D_p$  : Pitch circle diameter of gear mm
- $\alpha$  : Gear pressure angle
- $\beta$  : Gear helix angle

Actual gear load is determined by multiplying the theoretical load by the gear factor described in **Table 3.1**, because vibration and shock are added to each theoretical load determined by the above formulas.

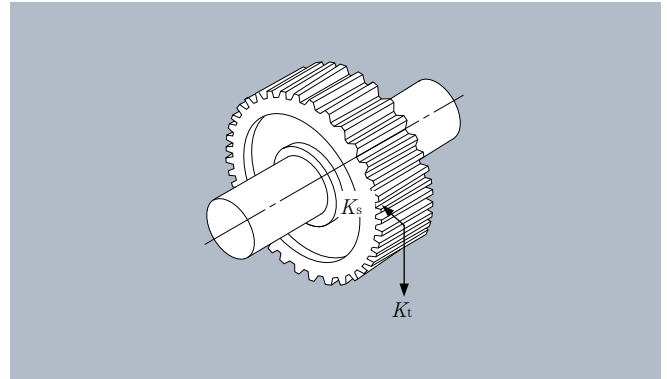


**Fig. 3.1 Load acting on spur gear**

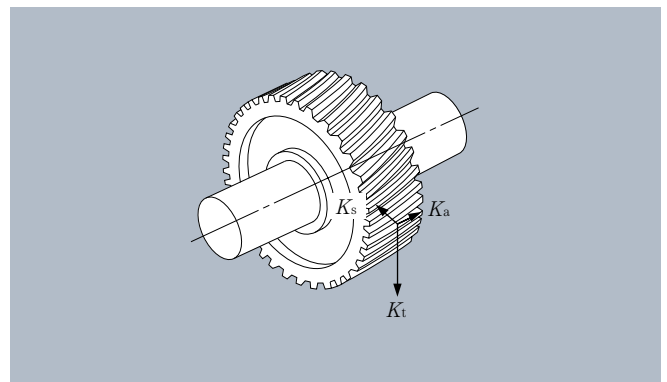


**Fig. 3.2 Load acting on helical gear**

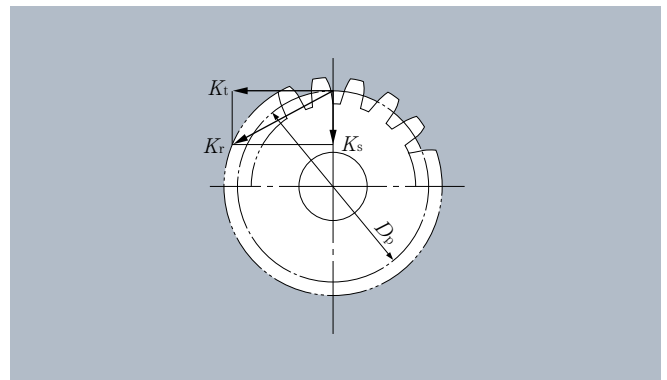


**Fig. 3.3 Composite radial force acting on gear**

**Table 3.1 Gear factor  $f_z$**

| Types of gear                                                            | $f_z$    |
|--------------------------------------------------------------------------|----------|
| Precision ground gears<br>(Pitch and profile errors of less than 0.02mm) | 1.05~1.1 |
| Ordinary machined gears<br>(Pitch and profile errors of less than 0.1mm) | 1.1~1.3  |



## (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.

**Table 3.2** shows how to calculate these loads.

The load acting on straight-tooth bevel gear can be determined from **Table 3.2**, assuming the helix angle as  $\beta = 0$ .

The symbols and units used in this table are as follows.

- $K_t$  : 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)
- HP : Transmission power kw
- $n$  : Rotational speed r/min
- $D_{pm}$  : Mean pitch circle diameter mm
- $\alpha$  : Gear pressure angle
- $\beta$  : Gear helix angle
- $\delta$  : Pitch cone angle of gear

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.

$$K_{sp} = K_{ag} \quad \text{.....(3.5)}$$

$$K_{ap} = K_{sg} \quad \text{.....(3.6)}$$

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)

For spiral bevel gears, the loading direction differs depending on the direction of helix angle, rotational direction and whether the spiral bevel gear is located at the drive side or the driven side.

The separating force ( $K_s$ ) acting direction and axial load ( $K_a$ ) acting direction illustrated in **Fig.3.5** are the positive direction respectively. On the other hand, the rotational direction and helix angle direction are to be defined viewing from the large end side of the gear. Hence, for the gear illustrated in **Fig. 3.5** these directions are clockwise and to right.

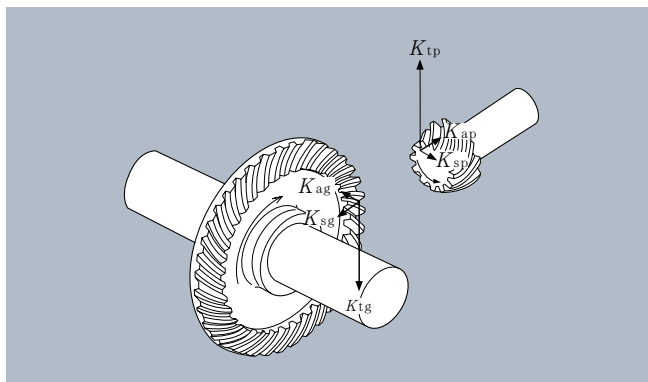


**Fig. 3.4** Load acting on bevel gears

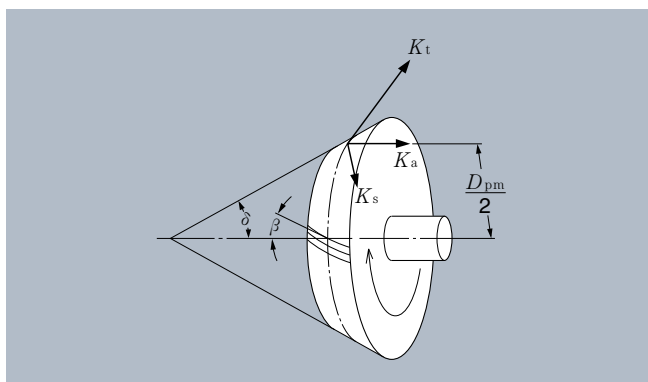


**Fig.3.5** Bevel gear diagram

**Table 3.2** Loads acting on bevel gears

Unit N

| Driving gears          | Rotational direction | Clockwise                                                                                                                 | Counter clockwise                                                                              | Clockwise                                                                                      | Counter clockwise                                                                              |
|------------------------|----------------------|---------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
|                        | Helix angle          | To right                                                                                                                  | To left                                                                                        | To left                                                                                        | To right                                                                                       |
| Tangential load $K_t$  |                      | $K_t = \frac{19.1 \times 10^6 \cdot H}{D_{pm} \cdot n}, \left\{ \frac{1.95 \times 10^6 \cdot H}{D_{pm} \cdot n} \right\}$ |                                                                                                |                                                                                                |                                                                                                |
| 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          | $K_s = K_t \left[ \tan \alpha \frac{\cos \delta}{\cos \beta} - \tan \beta \sin \delta \right]$                            | $K_s = K_t \left[ \tan \alpha \frac{\cos \delta}{\cos \beta} + \tan \beta \sin \delta \right]$ | $K_s = K_t \left[ \tan \alpha \frac{\cos \delta}{\cos \beta} + \tan \beta \sin \delta \right]$ | $K_s = K_t \left[ \tan \alpha \frac{\cos \delta}{\cos \beta} - \tan \beta \sin \delta \right]$ |
| 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          | $K_a = K_t \left[ \tan \alpha \frac{\sin \delta}{\cos \beta} + \tan \beta \cos \delta \right]$                            | $K_a = K_t \left[ \tan \alpha \frac{\sin \delta}{\cos \beta} - \tan \beta \cos \delta \right]$ | $K_a = K_t \left[ \tan \alpha \frac{\sin \delta}{\cos \beta} - \tan \beta \cos \delta \right]$ | $K_a = K_t \left[ \tan \alpha \frac{\sin \delta}{\cos \beta} + \tan \beta \cos \delta \right]$ |

## 3.1.2 Loads acting on chain and belt shafts

In the case of power transmission by a chain and a belt, the load acting tangentially on the sprocket or the pulley can be determined by **formula (3.7)**.

$$K_t = \frac{19.1 \times 10^6 \cdot HP}{D_p \cdot n} \left( \frac{1.95 \times 10^6 \cdot HP}{D_p \cdot n} \right) \dots\dots\dots (3.7)$$

where,

$K_t$  : Tangential load acting on sprocket or pulley N (kgf)

HP : Transmission power kW

$D_p$  : Pitch circle diameter of sprocket or pulley mm

In the case of belt driving, initial tension is applied to the belt so the pulley and the belt are both always pressed down with a proper load.

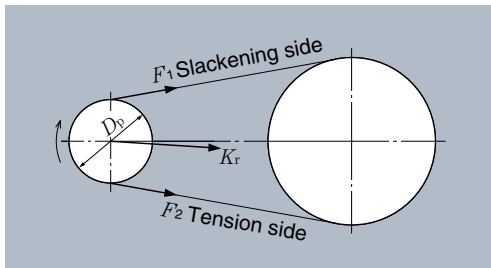


Fig. 3.6 Loads acting on chain/ belt

Considering this initial tension, radial load acting on the pulley is expressed in **formula (3.8)**.

In the case of chain driving, the radial load acting thereon can be expressed using the same formula, if vibration and shock are taken into consideration.

$$K_r = f_b \cdot K_t \dots\dots\dots (3.8)$$

where,

$K_r$  : Radial load acting on sprocket or pulley N (kgf)

$f_b$  : Chain/belt factor (**Table 3.3**)

Table 3.3 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 |

## 3.1.3 Load factor

In an actual machine, the shaft load is mostly greater than the theoretically calculated load due to vibration, shock, etc. The load acting on the shafts of a machine can be determined by **formula (3.9)**.

$$K = f_w \cdot K_c \dots\dots\dots (3.9)$$

where

$K$  : Actual load acting on shaft N(kgf)

$K_c$  : Theoretically calculated value N (kgf)

$f_w$  : Load factor (**Table 3.4**)

Table 3.4 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                                                                                                                                         |

## 3.2 Load distribution to bearings

Any loads acting on shafts are distributed to the bearings considering static tension to be supported with the bearings.

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

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

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

where,

$F_{rA}$  : Radial load acting on bearing-A N (kgf)

$F_{rB}$  : Radial load acting on bearing-B N (kgf)

$K_{rI}$  : Radial load acting on gear-I N (kgf)

$K_a$  : Axial load acting on gear-I N (kgf)

$K_{rII}$  : Axial load acting on gear-II N (kgf)

$D_p$  : Pitch circle diameter of gear-I mm

$l$  : Bearing to bearing distance mm

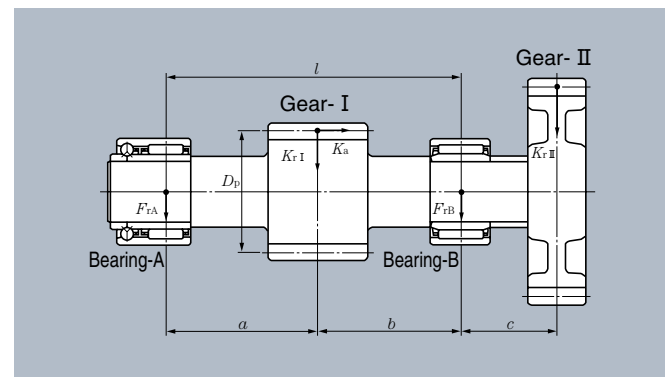


Fig. 3.7 Gear shaft

## 3.3 Mean load

The loads acting on bearings used in ordinary machines fluctuate mostly depending on the predetermined operation cycle or work plan. In such a case, the mean load  $F_m$  converted so the same lifetime is assigned to the bearings is used as the bearing load.

### (1) Stepped fluctuating load

Where bearing loads  $F_1, F_2, \dots, F_n$  act on and the rotational speed and running time are  $n_1, n_2, \dots, n_n$  and  $t_1, t_2, \dots, t_n$  respectively, the mean load  $F_m$  of these loads can be expressed in **formula (3.12)**.

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

where:

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

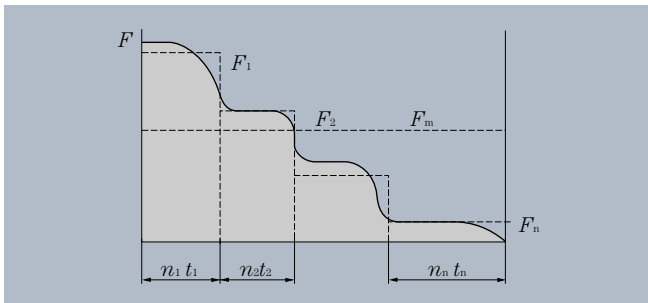


Fig. 3.8 Stepped fluctuating load

### (2) Consecutive series load

Where load is load cycle " $t_o$ " and it can be expressed in the function  $F(t)$  of time  $t$ , the mean load can be expressed in **formula (3.13)**.

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

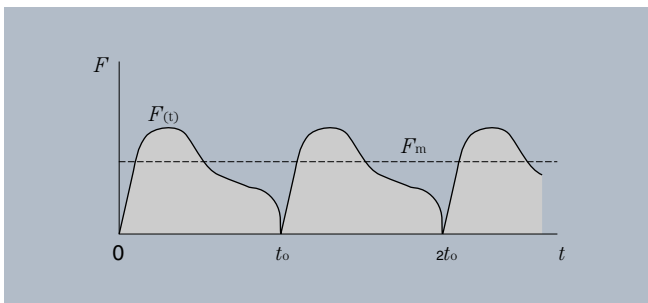


Fig. 3.9 Load fluctuating as a time function

### (3) Load fluctuating in nearly linear form

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

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

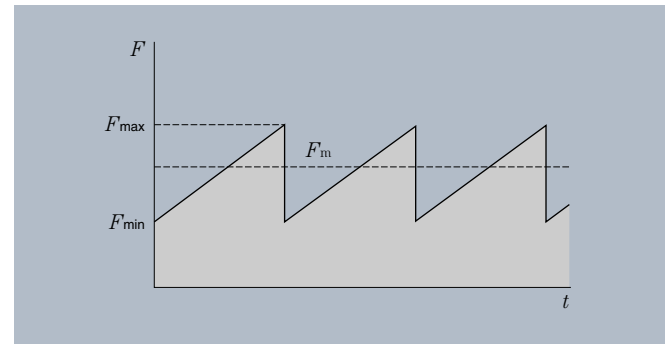


Fig. 3.10 Load fluctuating in linear form

### (4) Sinusoidal fluctuating load

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

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

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

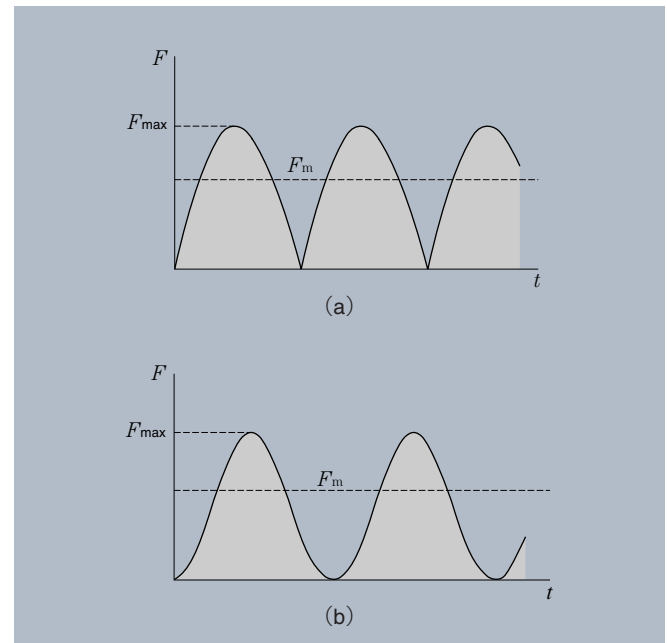


Fig. 3.11 Sinusoidal fluctuating load



## 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:

This means the allowable value for variation of each of bore diameter, mean bore diameter, outer diameter, mean outer diameter, and width or thickness of bearing ring (limited to thrust bearing).

### Running accuracy:

This means the respective allowable values for radial run-out and axial run-out of both inner ring and outer ring, lateral run-out of inner ring, and outer diameter run-out of outer ring.

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 application, 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 4.2 Dimensional item symbols used in applicable standards**

| 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 $\bigcirc$ <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 $\bigcirc$ <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 ↗                             |
|                      | $K_{ea}$        | Radial run-out of outer ring                           | Run-out ↗                             |
|                      | $S_{ia}$        | Axial run-out of inner ring                            | _____                                 |
|                      | $S_{ea}$        | Axial run-out of outer ring                            | _____                                 |
|                      | $S_d$           | Lateral run-out (inner ring)                           | Run-out ↗                             |
|                      | $S_D$           | Outer diameter run-out (outer ring)                    | Run-out ↗                             |

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 4.1 Bearing types and corresponding accuracy classes**

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



**Table 4.3 Tolerances for radial bearings**

**Table 4.3(1) Inner rings**

| Nominal bore diameter<br>$d$<br>mm |       | Dimensional tolerance for mean bore diameter<br>$\Delta_{dmp}$ |     |         |     |         |     |         |     | Variation of mean bore diameter<br>$V_{dp}$ |         |         |         | Allowable variation of bore diameter<br>$V_{dmp}$ |         |         |         |
|------------------------------------|-------|----------------------------------------------------------------|-----|---------|-----|---------|-----|---------|-----|---------------------------------------------|---------|---------|---------|---------------------------------------------------|---------|---------|---------|
| over                               | incl. | 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 | max                                         |         |         |         | max                                               |         |         |         |
| 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<br>$D$<br>mm |       | Dimensional tolerance for mean outer diameter<br>$\Delta_{Dmp}$ |     |         |     |         |     |         |     | Allowable variation of outer diameter<br>$V_{Dp}$ |         |         |         | Allowable variation of mean outer diameter<br>$V_{Dmp}$ |         |         |         |
|-------------------------------------|-------|-----------------------------------------------------------------|-----|---------|-----|---------|-----|---------|-----|---------------------------------------------------|---------|---------|---------|---------------------------------------------------------|---------|---------|---------|
| over                                | incl. | 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 | max.                                              |         |         |         | max.                                                    |         |         |         |
| 6 <sup>②</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.

Unit  $\mu\text{m}$ 

| Radial run-out<br>$K_{ia}$ |            |            |            | Face run-out<br>$S_d$ |            | Axial run-out<br>$S_{ia}$ ② |            | Allowable width deviation<br>$\Delta_{Bs}$ |              |              |              | Allowable width variation<br>$V_{Bs}$ |            |            |            | Nominal bore diameter<br>$d$<br>mm |       |
|----------------------------|------------|------------|------------|-----------------------|------------|-----------------------------|------------|--------------------------------------------|--------------|--------------|--------------|---------------------------------------|------------|------------|------------|------------------------------------|-------|
| Class<br>0                 | Class<br>6 | Class<br>5 | Class<br>4 | Class<br>5            | Class<br>4 | Class<br>5                  | Class<br>4 | Class<br>0,6                               | Class<br>5,4 | Class<br>0,6 | Class<br>5,4 | Class<br>0                            | Class<br>6 | Class<br>5 | Class<br>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 ①                              | 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<br>$K_{ea}$ |            |            |            | Outside surface inclination<br>$S_d$ |            | Axial run-out<br>$S_{ea}$ ① |            | Allowable width deviation<br>$\Delta_{Cs}$                           |  |  |  | Allowable width variation<br>$V_{Cs}$ |            |            |            | Nominal outer diameter<br>$D$<br>mm |       |
|----------------------------|------------|------------|------------|--------------------------------------|------------|-----------------------------|------------|----------------------------------------------------------------------|--|--|--|---------------------------------------|------------|------------|------------|-------------------------------------|-------|
| Class<br>0                 | Class<br>6 | Class<br>5 | Class<br>4 | Class<br>5                           | Class<br>4 | Class<br>5                  | Class<br>4 | Class 0,6,5,4                                                        |  |  |  | Class<br>0                            | Class<br>6 | Class<br>5 | Class<br>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. |  |  |  | 5                                     | 2.5        | 5          | 2.5        | 6 ②                                 | 18    |
| 15                         | 9          | 6          | 4          | 8                                    | 4          | 8                           | 5          |                                                                      |  |  |  | 5                                     | 2.5        | 5          | 2.5        | 18                                  | 30    |
| 20                         | 10         | 7          | 5          | 8                                    | 4          | 8                           | 5          |                                                                      |  |  |  | 5                                     | 2.5        | 5          | 2.5        | 30                                  | 50    |
| 25                         | 13         | 8          | 5          | 8                                    | 4          | 10                          | 5          |                                                                      |  |  |  | 6                                     | 3          | 6          | 3          | 50                                  | 80    |
| 35                         | 18         | 10         | 6          | 9                                    | 5          | 11                          | 6          |                                                                      |  |  |  | 8                                     | 4          | 8          | 4          | 80                                  | 120   |
| 40                         | 20         | 11         | 7          | 10                                   | 5          | 13                          | 7          |                                                                      |  |  |  | 8                                     | 5          | 8          | 5          | 120                                 | 150   |
| 45                         | 23         | 13         | 8          | 10                                   | 5          | 14                          | 8          |                                                                      |  |  |  | 8                                     | 5          | 8          | 5          | 150                                 | 180   |
| 50                         | 25         | 15         | 10         | 11                                   | 7          | 15                          | 10         |                                                                      |  |  |  | 10                                    | 7          | 10         | 7          | 180                                 | 250   |
| 60                         | 30         | 18         | 11         | 13                                   | 8          | 18                          | 10         |                                                                      |  |  |  | 11                                    | 7          | 11         | 7          | 250                                 | 315   |
| 70                         | 35         | 20         | 13         | 13                                   | 10         | 20                          | 13         |                                                                      |  |  |  | 13                                    | 8          | 13         | 8          | 315                                 | 400   |
| 80                         | 40         | 23         | —          | 15                                   | —          | 23                          | —          |                                                                      |  |  |  | 15                                    | —          | 15         | —          | 400                                 | 500   |
| 100                        | 50         | 25         | —          | 18                                   | —          | 25                          | —          |                                                                      |  |  |  | 18                                    | —          | 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<br>$d$ or $d_2$<br>mm |       | Allowable deviation of mean diameter<br>$\Delta_{dmp}$ or $\Delta_{d2mp}$ |     |         |     | Allowable variation of<br>bore diameter<br>$V_{dp}$ or $V_{d2p}$ |         | Allowable variation of raceway thickness <sup>①</sup><br>$S_i$ |         |         |         |
|---------------------------------------------|-------|---------------------------------------------------------------------------|-----|---------|-----|------------------------------------------------------------------|---------|----------------------------------------------------------------|---------|---------|---------|
| over                                        | incl. | Class 0, 6, 5                                                             |     | Class 4 |     | Class 0, 6, 5                                                    | Class 4 | Class 0                                                        | Class 6 | Class 5 | Class 4 |
|                                             |       | high                                                                      | low | high    | low | low                                                              | max     | max                                                            | max     | max     | max     |
| —                                           | 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       |

① 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**

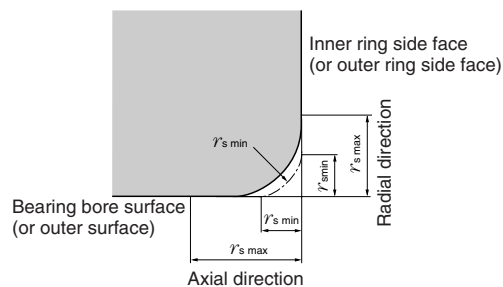
Unit  $\mu\text{m}$ 

| Nominal outer diameter<br>$D$<br>mm |       | Allowable deviation of mean outer diameter<br>$\Delta_{Dmp}$ |     |         |     | Allowable variation of<br>outer diameter<br>$V_{Dp}$ |         | Allowable variation of raceway thickness<br>$S_e$                                      |  |
|-------------------------------------|-------|--------------------------------------------------------------|-----|---------|-----|------------------------------------------------------|---------|----------------------------------------------------------------------------------------|--|
| over                                | incl. | Class 0,6,5                                                  |     | Class 4 |     | Class 0,6,5                                          | Class 4 | Class 0,6,5,4                                                                          |  |
|                                     |       | high                                                         | low | high    | low | max                                                  | max     | max                                                                                    |  |
| 10                                  | 18    | 0                                                            | −11 | 0       | −7  | 8                                                    | 5       | Depending on the applicable allowable value of $S_i$ 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

| $r'_s$ min ❶ | Nominal bore diameter $d$ |       | Radial direction | Axial direction |
|--------------|---------------------------|-------|------------------|-----------------|
|              | over                      | incl. | $r'_s$ max       |                 |
| 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               |

 ❶ Allowable minimum values for the chamfering dimension  $r'_{sR}$ .

**Table 4.5 (2) Thrust bearings**

Unit mm

| $r'_s$ min ❶ | Radial and axial directions |
|--------------|-----------------------------|
|              | $r'_s$ 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                         |

 ❶ Allowable minimum values for the chamfering dimension  $r'_{sR}$ .

**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                    | 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 Radial clearance

Radial clearance in bearing (initial radial clearance) means the displacement value of bearing ring when the non-fixed ring was displaced in radial direction with either one of the inner ring and outer ring remained fixed, before the bearing is installed on a shaft or in a housing.

#### Machined ring needle roller bearing (with inner ring) ;

The initial clearance values for this bearing type are as shown in **Table 5.1**. **Table 5.1 (1)** shows the interchangeable clearances, which are remained unchanged even after inner ring or outer ring was reassembled in. **Table 5.1(2)** shows non-interchangeable clearances, which do not allow reassembly of inner ring or outer ring due to the narrow clearance range. The bearing clearances are represented by the symbols of C2, ordinary, C3 and C4 in the order from the smallest one and the non-interchangeable clearance symbols are followed by "NA" for identification.

**For the radial clearance values for bearing types other than the machined ring needle roller bearings, refer to "Commentary" described in the respective Dimensions Table.**

### 5.2 Running clearance

#### 5.2.1 Setting up running clearance

Bearing clearance in running, that is, running clearance gets generally smaller than the initial radial clearance, depending on the fits and temperature difference between the inner ring and the outer ring. This running clearance must be set up optimally because setting up it improperly would lead to shorter life, overheat and vibration or running noise of bearing.

Theoretically the bearing life comes to the maximum when the running clearance of bearing in normal running is slightly negative, but it is difficult to always hold this optimal condition during actual running. If the negative clearance value gets larger due to change of somewhat operating condition, it would cause significant reduction of bearing lifetime and overheat. To avoid such phenomena, generally proper initial radial clearance is selected and set up so the running clearance gets slightly larger than 0 (zero).

In the case of usual operating conditions, in other words, application of the fits based on ordinary load, usual rotational speed and running temperature, etc., an optimal running clearance can be got by selecting an ordinary clearance.

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

Unit  $\mu\text{m}$

| Nominal bore diameter<br><i>d</i> (mm) |       | Radial clearance |     |          |     |     |     |     |     |
|----------------------------------------|-------|------------------|-----|----------|-----|-----|-----|-----|-----|
|                                        |       | C2               |     | Normal ① |     | 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 |

① Supplementary suffix codes of clearance is not added to bearing numbers.

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

Unit  $\mu\text{m}$

| Nominal bore diameter<br><i>d</i> (mm) |       | Radial clearance |     |      |     |      |     |      |     |
|----------------------------------------|-------|------------------|-----|------|-----|------|-----|------|-----|
|                                        |       | C2NA             |     | NA ② |     | 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                                    | 160   | 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 |

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



## 5.2.2 Calculation of running clearance

The running clearance in bearing can be determined from initial radial clearance, reduced internal clearance incurred by effective interference, and temperature difference between inner ring and outer ring, using formula (5.1).

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

where,

- $\delta_{\text{eff}}$  : Running clearance mm
- $\delta_o$  : Initial radial clearance mm
- $\delta_f$  : Reduced internal clearance incurred by effective interference mm
- $\delta_t$  : Reduced internal clearance incurred by temperature difference between inner ring and outer ring mm

### (1) Reduced internal clearance incurred by effective interference

When a bearing is installed on a shaft or in a housing with some effective interference, the inner ring expands and the outer ring shrinks and, as the result, the radial clearance in the bearing reduces correspondingly.

The expansion or shrinkage of inner ring or outer ring is approximately equivalent to 85% of the effective interference though depending on bearing type, shaft or housing profile, dimension and material. For the detail refer to **Table 6.4** on page A-35.

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

where,

- $\delta_f$  : Reduced internal clearance incurred by effective interference mm
- $\Delta_{\text{deff}}$  : Effective interference mm

### (2) Reduced internal clearance incurred by temperature difference between inner ring and outer ring

When a bearing is in running, the temperature of its outer ring is lower by 5 to 10°C than that of its inner ring or rolling elements. Also, temperature difference between the inner ring and the outer ring gets larger when heat is radiated more from the housing or when the bearing shaft is communicated with a heat source and a heated fluid is flowing through a hollowed shaft. In such a case, the internal clearance reduces corresponding to thermal expansion difference between the inner ring and the outer ring which is incurred by this temperature difference.

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

where,

- $\delta_t$  : Reduced clearance value incurred by 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  $^\circ\text{C}$
- $D_o$  : Outer ring raceway diameter mm
- $d$  : Bearing bore diameter mm
- $D$  : Bearing outer diameter mm

When a shaft or a housing is used as a direct raceway, temperature difference between the shaft and the housing is applied as temperature difference ( $\Delta T$ ).

## 5.3 Fits and bearing radial clearance

Where the allowable tolerances for the shaft and the housing hole are already decided, the simple nomogram as shown in **Fig. 5.1** is available as a guideline to decision of the initial radial clearance of bearing so as to enable to get an optimal clearance after the bearing was installed on the shaft/in the housing. The nomogram in **Fig. 5.1** is used as the guideline as stated above. For the detail feel free to contact **NTN**.

For example, where the fit condition for needle roller bearing with inner ring is already given as J7m6, **Fig.5.1** shows that clearance C3 must be secured to get the standard running clearance after installation.

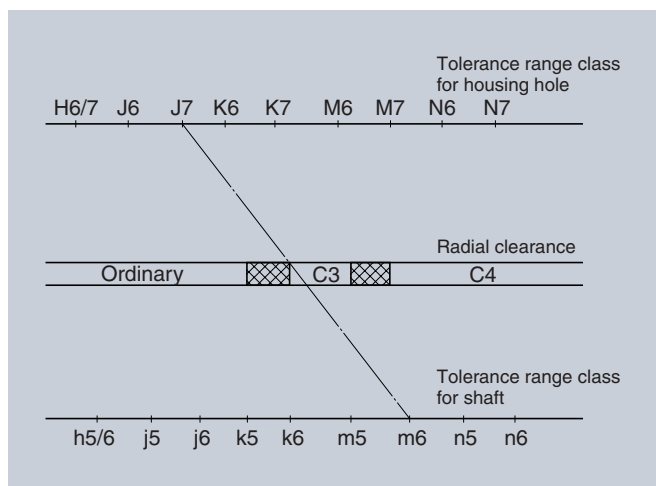


**Fig. 5.1 Relationship between bearing fits and radial clearance**

## 7. Bearing Fits

### 6.1 Interference

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. Such a relative movement, if occurred, would result in wear, fretting corrosion, friction crack, etc. on the fitted surfaces, which would then cause damage of the bearing and the shaft or the housing. Furthermore, wear powder invades into the bearing, then causing imperfect rotation, abnormal overheat, vibration, etc.

The most effective way to fix a bearing is to assign an proper interference to the fitted surfaces between the bearing ring and the shaft or the housing and to thereby apply "tight fit" to the bearing. 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 enabling to separate 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 of its inner ring and outer ring. In the case of "tight fit", the easiness of bearing installation and removal is lost and, therefore, the bearing ring subjected to stationary load can be "loose-fitted".

### 6.2 Necessity of proper fit

Improper fit could lead to damage and shorter life of 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.

- Crack and earlier separation of bearing ring, and displacement of bearing ring
- Wear of bearing ring, shaft and housing caused by creep and fretting corrosion
- Seizure (sticking) caused by less 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.

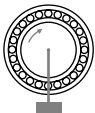
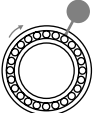
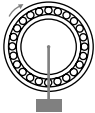
The loads acting on each bearing ring are divided into running load, stationary load and directionally unstable load according to the direction and characteristic of loads acting on the bearing.

"Tight fit" can be selected for a bearing ring subjected to running load and directionally unstable load and "stationary fit" or "loose fit" be selected for a bearing ring subjected to stationary load. (See **Table 6.1**)

Where load of high magnitude or vibration and shock loads act on a bearing or a light alloy/plastic housing is used, it is necessary to secure a large interference. In that case, **however, the housing rigidity must be considered carefully so as not allow occurrence of split damage, etc.**

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 apply a large interference thereto. 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. The said bearings of high accuracy are used to prevent such possible phenomena.

**Table 6.1 Radial load and bearing fit**

| Bearing running conditions                                                                                          | Sketch                                                                               | Load characteristic         | Bearing fit               |                           |
|---------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|-----------------------------|---------------------------|---------------------------|
|                                                                                                                     |                                                                                      |                             | Inner ring                | Outer ring                |
| Inner ring : Rotation<br>Outer ring: static<br>Load direction: constant                                             |   | Rotating inner ring load    | Tight fit                 | Loose fit acceptable, too |
| Inner ring: static<br>Outer ring: rotation<br>Load direction: rotating with outer ring                              |   | Static outer ring load      |                           |                           |
| Inner ring: static<br>Outer ring: rotation<br>Load direction: constant                                              |   | Rotating inner ring load    | Loose fit acceptable, too | Tight fit                 |
| Inner ring: rotation<br>Outer ring: static<br>Load direction : rotating with inner ring                             |   | Static outer ring load      |                           |                           |
| Inner ring: rotation or static<br>Outer ring: rotation or static<br>Load direction: The direction can not be fixed. | Load direction is non-constant due to directional fluctuation, unbalanced load, etc. | Directionally unstable load | Tight fit                 | Tight fit                 |

## 6.4 Recommended Fits

The dimensional tolerances for the diameter of a shaft and the hole 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 (Dimensional Tolerances and Bearing Fits). Hence, bearing fits is determined by selection of the dimensional tolerances for shaft diameter and hole diameter as applicable. **Fig. 6.1** shows the relationship between shaft diameter and bearing bore diameter and between housing hole

diameter and bearing outer diameter.

**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.**

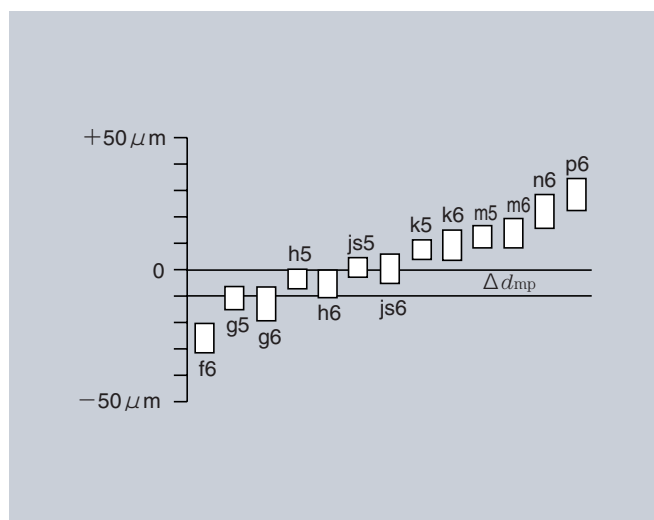


Fig. 6.1 (a) Bearing fits on shaft

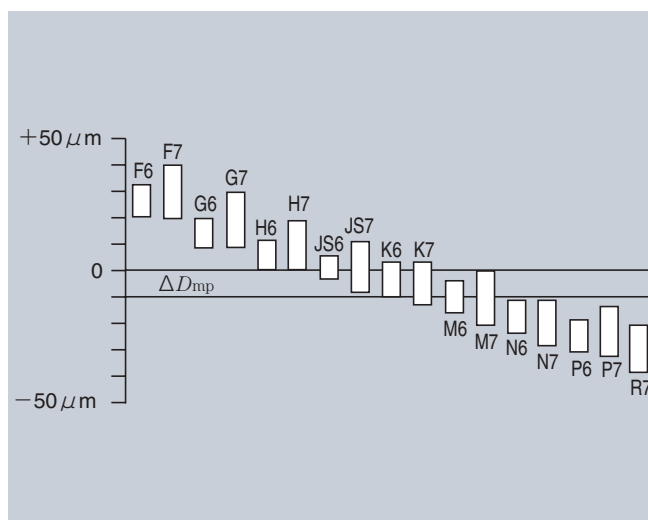


Fig. 6.1(b) Bearing fits in housing hole

Table 6.2 Machined ring needle roller bearing fits

Table 6.2 (1) Dimensional tolerance for shaft diameter

| Conditions                                              |                                            |                       | Tolerance range class |
|---------------------------------------------------------|--------------------------------------------|-----------------------|-----------------------|
| Load characteristic                                     | Load magnitude                             | Shaft diameter $d$ 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                    |
| 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) Dimensional tolerances for housing

| Conditions                                                 |                                  | Tolerance range class |
|------------------------------------------------------------|----------------------------------|-----------------------|
|                                                            |                                  |                       |
| 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 :  $P_r \leq 0.06C_r$

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

Heavy load :  $P_r > 0.12C_r$

**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<br>$d$<br>mm |       | Allowable deviation of mean bore diameter<br>$\Delta d_{\text{imp}}$ | g6      |         | h5      |         | h6      |        | j5      |         | k5       |       | m5      |       | m6      |       | n6      |       |
|------------------------------------|-------|----------------------------------------------------------------------|---------|---------|---------|---------|---------|--------|---------|---------|----------|-------|---------|-------|---------|-------|---------|-------|
|                                    |       |                                                                      | Bearing | Shaft   | Bearing | Shaft   | Bearing | Shaft  | Bearing | Shaft   | Bearing  | Shaft | Bearing | Shaft | Bearing | Shaft | Bearing | Shaft |
|                                    |       |                                                                      |         |         |         |         |         |        |         |         |          |       |         |       |         |       |         |       |
| pver                               | 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   |                                                                      |         |         |         |         |         |        |         |         |          |       |         |       |         |       |         |       |
| 355                                | 400   | 0                                                                    | -40     | 22T~54L | 40T~25L | 40T~36L | 47T~18L | 69T~4T | 86T~21T | 97T~21T | 113T~37T |       |         |       |         |       |         |       |
| 400                                | 450   |                                                                      |         |         |         |         |         |        |         |         |          |       |         |       |         |       |         |       |
| 450                                | 500   |                                                                      |         |         |         |         |         |        |         |         |          |       |         |       |         |       |         |       |

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

 Unit  $\mu\text{m}$ 

| Nominal outer diameter<br>$D$<br>mm |       | Allowable deviation of mean outer diameter<br>$\Delta D_{\text{mp}}$ | 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~1L  |         |         |         |         |         |         |
| 10                                  | 18    | 0                                                                    | -8      | 0~26L   | 8T~18L  | 9T~10L  | 12T~14L | 18T~8L  | 23T~3L  | 29T~3L  |         |         |         |         |         |         |
| 18                                  | 30    | 0                                                                    | -9      | 0~30L   | 9T~21L  | 11T~11L | 15T~15L | 21T~9L  | 28T~2L  | 35T~5L  |         |         |         |         |         |         |
| 30                                  | 50    | 0                                                                    | -11     | 0~36L   | 11T~25L | 13T~14L | 18T~18L | 25T~11L | 33T~3L  | 42T~6L  |         |         |         |         |         |         |
| 50                                  | 80    | 0                                                                    | -13     | 0~43L   | 12T~31L | 15T~17L | 21T~22L | 30T~13L | 39T~4L  | 52T~8L  |         |         |         |         |         |         |
| 80                                  | 120   | 0                                                                    | -15     | 0~50L   | 13T~37L | 18T~19L | 25T~25L | 35T~15L | 45T~5L  | 59T~9L  |         |         |         |         |         |         |
| 120                                 | 150   | 0                                                                    | -18     | 0~58L   | 14T~44L | 21T~22L | 28T~30L | 40T~18L | 52T~6L  | 68T~10L |         |         |         |         |         |         |
| 150                                 | 180   | 0                                                                    | -25     | 0~65L   | 14T~51L | 21T~29L | 28T~37L | 40T~25L | 52T~13L | 68T~3L  |         |         |         |         |         |         |
| 180                                 | 250   | 0                                                                    | -30     | 0~76L   | 16T~60L | 24T~35L | 33T~43L | 46T~30L | 60T~16L | 79T~3L  |         |         |         |         |         |         |
| 250                                 | 315   | 0                                                                    | -35     | 0~87L   | 16T~71L | 27T~40L | 36T~51L | 52T~35L | 66T~21L | 88T~1L  |         |         |         |         |         |         |
| 315                                 | 400   | 0                                                                    | -40     | 0~97L   | 18T~79L | 29T~47L | 40T~57L | 57T~40L | 73T~24L | 98T~1L  |         |         |         |         |         |         |
| 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.

## 6.5 Interference Calculation

### (1) Load and required interference

When radial load acts on a bearing, the interference required to prevent a clearance between its inner ring and a steel solid shaft can be expressed in **formulas (6.1)** and **(6.2)**.

For  $F_r \leq 0.3 C_{0r}$ ,

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

For  $F_r > 0.3 C_{0r}$ ,

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

Where,

- $\Delta d_F$  : Required effective interference    mm
- $d$  : Bearing bore diameter    mm
- $B$  : Inner ring width    mm
- $F_r$  : Radial load    N (kgf)
- $C_{0r}$  : Basic static load rating    N (kgf)

### (2) Temperature rise and required interference

When temperature rise of bearing (difference between bearing temperature and ambient temperature) is inevitable incurred by bearing running, the interference required to prevent a clearance between the inner ring and a steel shaft can be expressed in **formula (6.3)**.

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

Where,

- $\Delta d_T$  : 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    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 reduced value differs depending on the fitting surface roughness and generally the following reduction values must be prospected.

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

### (4) Maximum interference

Bearing ring fitted, with interference, on a shaft or in a housing results in tensile stress or compressive stress. Over-interference could cause cracking /splitting of bearing and short fatigue life of bearing. Therefore, in general the maximum interference is secured at 1/1000 and less of shaft diameter or otherwise it is secured so the circumferential maximum stress generating on the fitting surface comes to 130MPa or less. (See **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.6.2**) 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<br>$p$ MPa                       | $p_i = \frac{E}{2} \frac{\Delta d_{\text{eff}}}{d} \frac{(1-k^2)(1-k_o^2)}{1-k^2 k_o^2}$ | $p_e = \frac{E}{2} \frac{\Delta D_{\text{eff}}}{D} \frac{(1-h^2)(1-h_o^2)}{1-h^2 h_o^2}$ |
| Circumferential maximum stress<br>$\sigma$ MPa    | $\sigma_i = p_i \frac{1+k^2}{1-k^2}$ (Tensile stress)                                    | $\sigma_e = p_e \frac{2}{1-h^2}$ (Compressive stress)                                    |
| Radial elastic deformation of raceway<br>$\Delta$ | $\Delta_i = \Delta d_{\text{eff}} \cdot k \frac{1-k_o^2}{1-k^2 k_o^2}$ (Expansion)       | $\Delta_e = \Delta D_{\text{eff}} \cdot h \frac{1-h_o^2}{1-h^2 h_o^2}$ (Shrinkage)       |

Where,

$$k = \frac{d}{d_i}, \quad k_o = \frac{d_o}{d}, \quad h = \frac{D_e}{D}, \quad h_o = \frac{D}{D_o}$$

#### Remarks (Symbol representation)

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

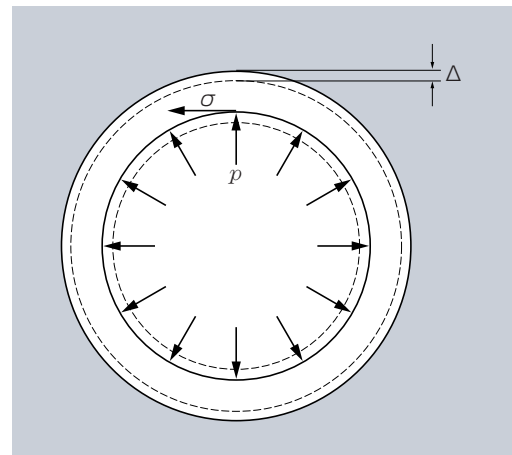


**Fig.6.2**

## 7. 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. Particularly for needle roller bearings the shaft and the housing must be designed under special consideration because the bearing ring thickness is thinner than that of other rolling bearings.

### 7.1 Design of bearing installing portions

Where a needle roller bearing with cage is used as an individual and is guided in axial direction directly by shaft shoulder (**Fig.7.1**), the shaft shoulder with which the cage side face comes in contact must be finished accurately and also is not allowed to have any raiser thereon. For a needle roller bearing subjected to high speed running, its contact surface is hardened and thereafter fine-finished by grinding.

When a snap ring is used for axial guide of the cage (**Fig.7.1**), a thrust ring is inserted between the cage and the snap ring to prevent the cut section of the snap ring from contacting directly the cage. NTN shaft snap ring WR type specially designed for NTN needle roller bearings is available as the snap ring intended for axial guide of bearing cage. (Refer to Dimensions Table on page B-227.)

On other hand, radial needle roller bearing can move freely in axial direction so that a ball bearing or a thrust bearing is used at single side for axial positioning of the shaft. Where axial load is less and, in addition, rotational speed is not so high(Ex. idle gear in a gear box), a thrust ring is fitted on the shaft, as illustrated in **Fig. 7.2** and a sliding bearing is formed between the thrust ring and the outer ring or the housing end face for the purpose of axial positioning. In such a design, good care must be exercised so the guide surface is fully lubricated. **Fig.7.3** 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.

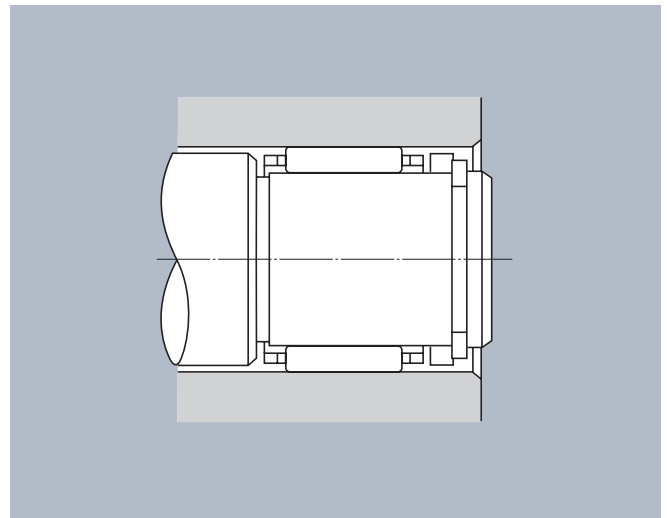


**Fig. 7.1** Bearing fixing by thrust ring

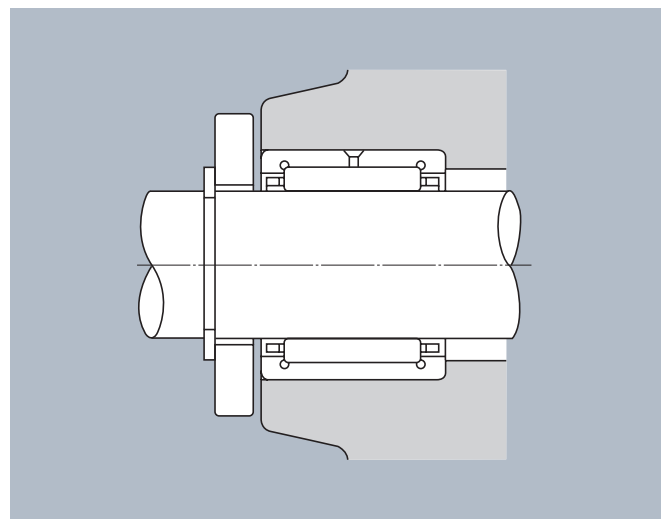


**Fig. 7.2** Bearing fixing in axial direction

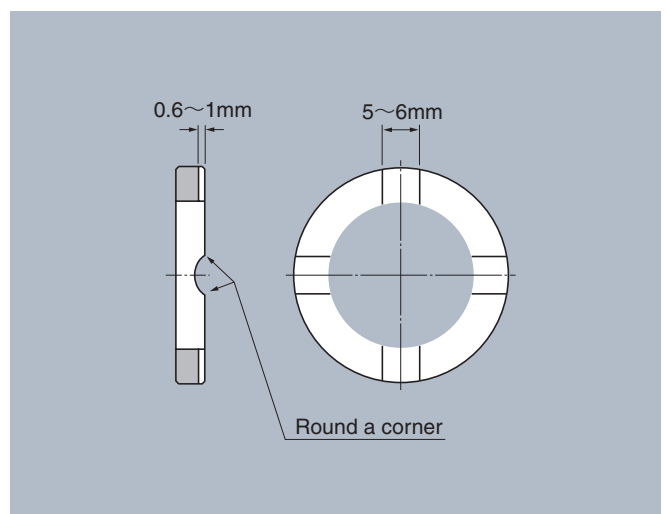


**Fig. 7.3** Design of thrust ring guide surface



## (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 is rounded smaller than the inner ring chamfer dimension.

Where the corner roundness  $r_a \text{ max}$  must be made larger for specific shaft strength (**Fig.7.4a**) or the shaft shoulder is low (**Fig. 7.4b**), a spacer must be inserted between the shaft shoulder and the inner ring to hold a full contact surface with the inner ring. Furthermore, for facilitating inner ring pull-out work the shaft shoulder is provided with a notched groove, as illustrated in **Fig. 7.5**, to accept an inner ring pull-out jig (puller).

NTN snap ring WR type for shaft use (Refer to Dimensions Table on page B-227) can be used for simply fixing inner ring in axial direction. (**Fig. 7.6**) Moreover, inner ring can be fixed in axial direction using an end plate or a side ring as illustrated in **Figs. 7.7** and **7.8**.

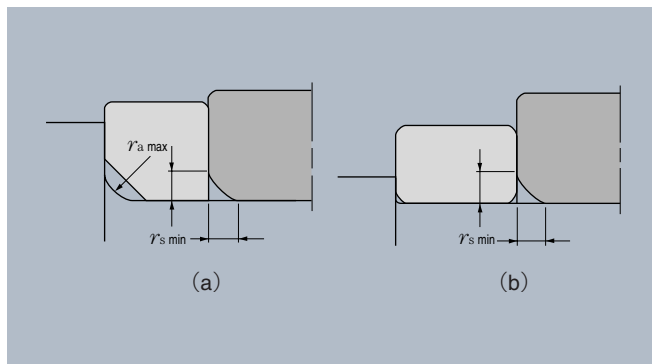


Fig. 7.4 Inner ring fixing by use of spacer

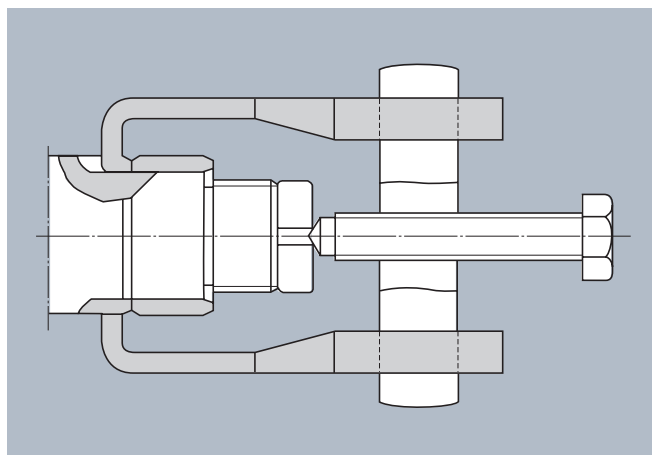


Fig. 7.5 Inner ring pull-out jig (puller)

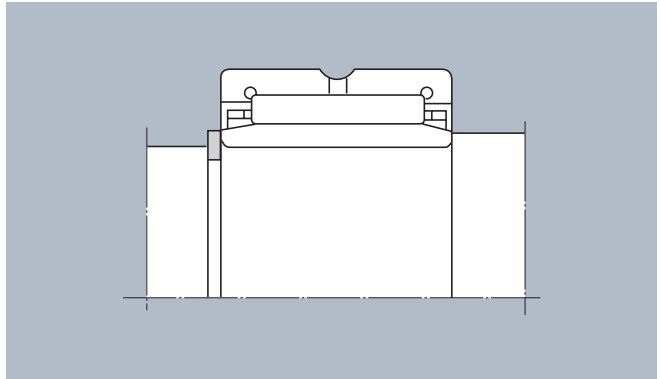


Fig. 7.6 Inner ring fixing by snap ring

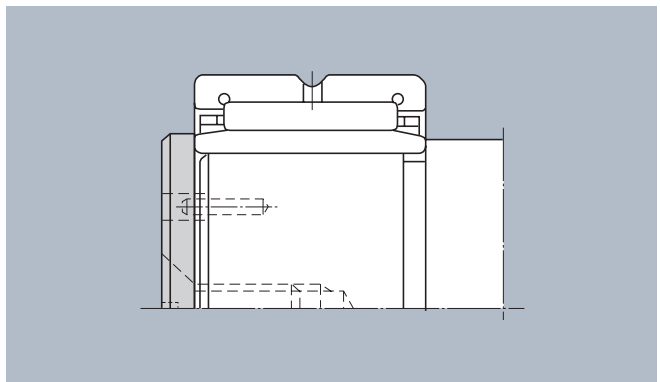


Fig. 7.7 Inner ring fixing by end plate

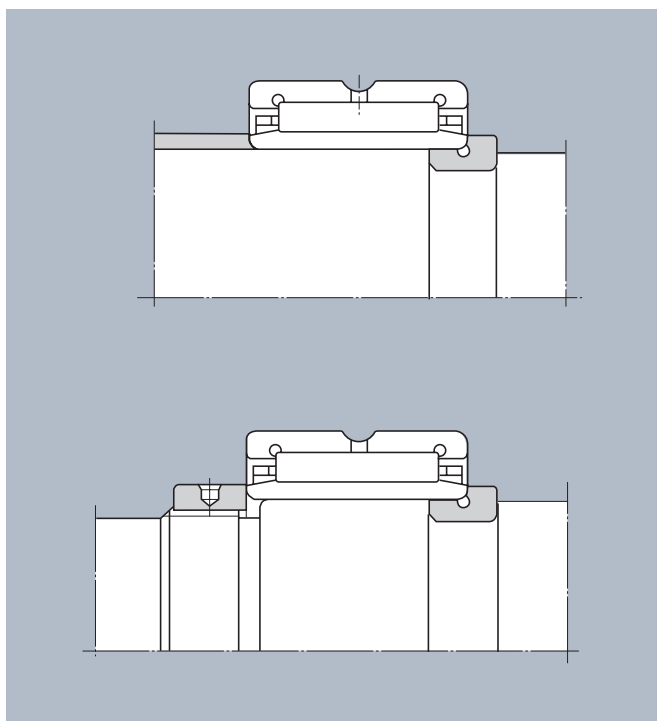


Fig. 7.8 Inner ring fixing by side ring

## (2) Outer ring

Similarly to Para. 7.1(1) "Inner Ring", good care exercised of the shoulder profile of bearing housing for fixing outer ring in axial direction.

**Figs. 7.9 and 7.10** illustrate the methods of fixing outer ring in axial direction.

NTN housing snap ring BR type (Refer to Dimensions Table on page B-229) can be used for fixing outer ring in axial direction. 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.

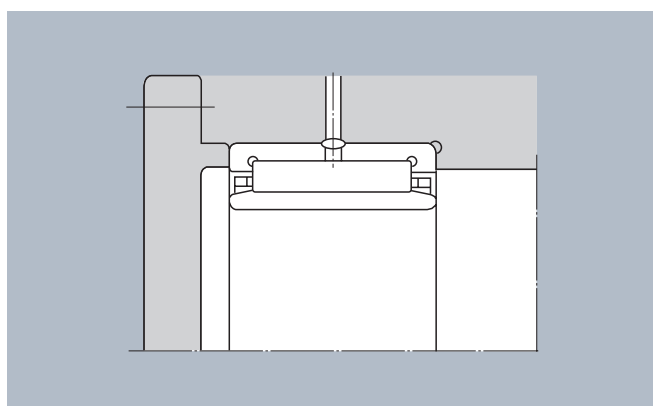


**Fig. 7.9** Outer ring fixing by lid

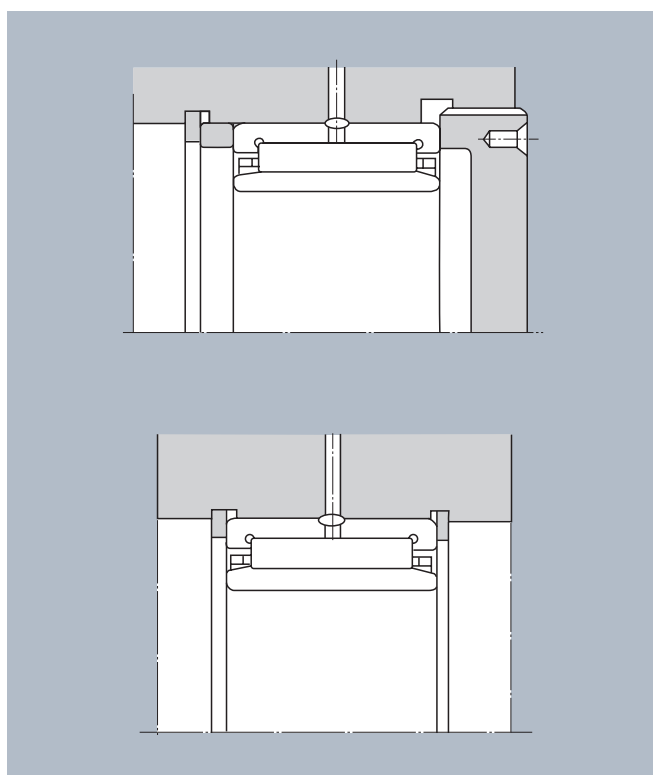


**Fig. 7.10** Outer ring fixing by snap ring

## 7.2 Bearing fitting dimensions

The respective shoulder heights " $h$ " of shaft and housing are designed larger than the maximum chamfer dimension  $r_{s \max}$  for bearing so the bearing end face comes in contact with the flat zone. And the corner roundness " $r_{as}$ " is designed smaller than the minimum chamfer dimension " $r_s$ " of bearing so as not to interfere with the bearing. Generally the radius of shaft and housing corner roundness shown in **Table 7.1** is used as the shoulder heights of 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 shoulder.

When the fitting surface of shaft or housing is finished by grinding, the shoulder corner must be provided with a relief. This relief dimension is as shown in **Table 7.2**.

**Table 7.1** 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             | 6        |
| 3          | 2.5           | 6.5      |
| 4          | 3             | 8        |

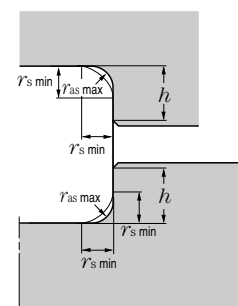
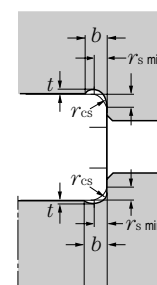


**Table 7.2** Relief grinding dimension for shaft and housing corners

| 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          | 3.7 | 0.5 | 3        |
| 4          | 5.9 | 0.5 | 4        |



## 7.3 Shaft and housing accuracy

Because of its thin wall, the raceway surface accuracy of needle roller bearing ring is influenced by the respective fitting surface accuracy of a shaft /a housing on/in which the needle roller bearing is installed. In the case of general operating conditions, the fitting surfaces of shaft and housing may be finished by lathe-turning, but those must be finished by grinding where the acting load is great and, in addition, the requirements for accuracy and sound are strict.

**Table 7.3** shows the fitting surface accuracy, profile accuracy, surface roughness, and shoulder perpendicularity to fitting surface of each of shaft and housing under ordinary operating conditions.

**Table 7.3 Shaft and housing accuracy**

| Characteristic item             | Shaft     | Housing   |
|---------------------------------|-----------|-----------|
| Dimensional accuracy            | IT6 (IT5) | IT7 (IT6) |
| Roundness cylindricality (max)  | IT3 (IT2) | IT4 (IT3) |
| Shoulder perpendicularity (max) | IT5 (IT4) | IT5 (IT4) |
| Fitting surface roughness       | 0.8a      | 1.6a      |

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

Where a two-split housing is used, deformation of outer ring by housing clamping can be minimized by providing a relief on the mating surface at bore side.

## 7.4 Raceway surface accuracy

For needle roller bearings, shaft and housing are used as the raceway surface on application. The raceway dimensional accuracy, profile accuracy and surface roughness of shaft/housing must be equivalent to the raceway accuracy of bearing itself. **Table 7.4** shows the specified surface accuracy and surface roughness of shaft/housing raceway.

**Table 7.4 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 (IT2)                                                                                                                                          | IT3 (IT2) |
| Axial run-out Thrust bearing (max) | IT5 (IT4)                                                                                                                                          |           |
| Surface roughness                  | For shaft diameter of $\phi$ 80 and less :0.2a<br>For shaft diameter of over $\phi$ 80 to 120 :0.3a<br>For shaft diameter of over $\phi$ 120 :0.4a |           |

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

## 7.5 Material and hardness of raceway surface

When the outer surface or bore surface of shaft(hollowed) or housing is used as raceway, it must be hardened to HRC58 to 64 for getting sufficient load capacity. For that, the materials shown in **Table 7.5** are used after heat-treated properly.

**Table 7.5 Materials used for raceway**

| Kinds of steel                   | Representative example | Related standards |
|----------------------------------|------------------------|-------------------|
| High carbon chrome bearing steel | SUJ2                   | JIS G 4805        |
| Carbon tool steel                | SK3                    | JIS G 4401        |
| Nickel chrome molybdenum steel   | SNCM420                | JIS G 4103        |
| Chrome steel                     | SCr420                 | JIS G 4104        |
| Chrome molybdenum steel          | SCM420                 | JIS G 4105        |
| Nickel chrome steel              | SNC420                 | JIS G 4102        |

When steel is surface-hardened by carburizing or carbonitriding, JIS Standard as applicable 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 (7.1)**.

$$E_{ht \min} \geq 0.8D_w (0.1 + 0.002 D_w) \quad \text{.....(7.1)}$$

Where,

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

$D_w$  : Roller diameter mm

## 7.6 Allowable bearing inclination

The inner ring and outer ring of 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 7.6** must be used as a guideline in the case of general applications because even minor inclination of inner ring and outer ring could cause reduction of bearing life and damage of cage.

**Table 7.6**

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

## 8. Lubrication

The purpose of lubricating bearings is to form a thin oil film on the rolling and sliding surfaces and to thereby prevent metal to metal direct contact. Furthermore, lubricating rolling bearings has the following effects.

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

For achieving these lubrication effects it is necessary to select a good quality lubricant, to remove dust from the lubricant, and to design a proper seal structure for prevention of lubricant leak as well as to adopt the lubrication method suitable to the respective actual operating conditions.

Rolling bearings are mostly lubricated with grease or oil, but solid lubricants such as molybdenum disulfide, graphite, etc. are used for special application.

Further, the comparative data of grease lubrication and oil lubrication given in **Table 8.1** can be utilized as the selection guide.

**Table 8.1 Characteristic comparison of grease lubrication with oil lubrication**

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

◎ : Extraordinarily advantageous

○ : Advantageous

△ : Fairly advantageous

× : Disadvantageous

### 8.1 Grease lubrication

Grease lubrication is the simplest lubrication method. This method enabling to simplify design of the seal structure is broadly used.

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

Furthermore, for grease replenishment it is desirable to provide a grease sector and a grease valve, etc. as a grease replenisher. **Fig. 8.1** illustrates an example of bearing unit with grease sector and grease valve.

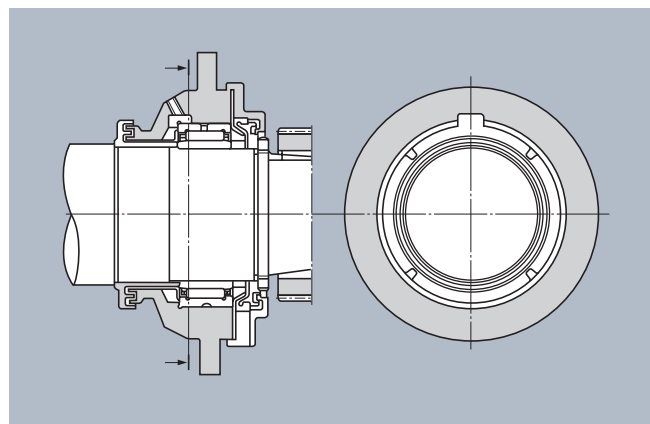


**Fig. 8.1 An example of bearing unit with grease sector and grease valve**

#### 8.1.1 Types and characteristics of grease

Lubrication oil 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 is determined by the kinds and combination of base oil, thickener and additives.

**Table 8.2** shows the general types of grease and their characteristics. Even the grease of same type is significantly different in the performance depending on the grease brand selected. In selecting a grease brand, therefore, it is necessary to verify the property data submitted from the grease manufacturer.

#### 8.1.2 Base oil

Mineral oil or synthetic oils such as diester oil, and synthetic oil such as silicone oil, fluorocarbon oil, etc. are used as the base oil for grease.

The lubrication performance of grease is mainly determined by the lubrication performance of the base oil. In general, a grease composed of low viscosity base oil is excellent in low temperature characteristic and high speed performance and, on the other hand, a grease composed of high viscosity base oil is excellent in high load characteristic.

#### 8.1.3 Thickener

Thickener is blended and diffused in base oil to hold grease in semi-solid form. And various thickeners are available for use as follows; thickener composed of metallic soap such as lithium, sodium or calcium, etc., thickener composed of inorganic material such as silica gel, bentonite, etc., and non-soap base thickener composed of organic material such as polyurea, fluorocarbon, etc.

The grease characteristics such as critical operating temperature, mechanical stability, durability, etc. are mainly determined by the kind of thickener used. In general, the sodium soap base grease is inferior to others in water resistance. Non-metallic soap base thickener composed of bentone, polyurea, etc. is excellent in high temperature characteristic.

Table 8.2 Grease varieties and characteristics

| Grease name                       | Lithium grease                                                           |                                                                               |                                                                                                                        | Sodium grease<br>(Fiber grease)                                                                              | Calcium<br>compound base<br>grease                                                                           | Aluminum<br>grease                                                                         | Non-soap grease                                                                                                                                                                                                                                                                                  |               |
|-----------------------------------|--------------------------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Thickener                         | Li soap                                                                  |                                                                               |                                                                                                                        | Na soap                                                                                                      | Ca+Na soap<br>Ca+Li soap                                                                                     | Al soap                                                                                    | Bentone, silica gel, urea,<br>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<br>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.<br><br>Grease for universal type rolling bearings. | Excellent in low temperature characteristic and anti-friction characteristic. | suited to high temperature and low temperature.<br><br>Low oil film strength and unsuitable for high load application. | emulsified by inclusion of water content.<br><br>Comparatively excellent in high temperature characteristic. | Excellent in water resistance and mechanical stability.<br><br>Suitable for bearing subjected to shock load. | Excellent in viscosity characteristic.<br><br>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.<br><br>Grease for universal type rolling bearings. |               |

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

### 8.1.4 Additives

Any greases contain various additives to improve the performance, for example, containing oxidation inhibitor, extreme pressure additives (EP additives), rust inhibitor, corrosion inhibitor, 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 no grease is replenished for a long time.

### 8.1.5 Consistency

"Consistency" is an index showing the hardness or fluidity of grease. The greater numerical value thereof is the softer hardness. This consistency is determined by the amount of thickener and the viscosity of base oil. Usually NLGI consistency codes 1 and 2 or 3 are used for lubrication of bearings.

**Table 8.3** shows the general relationship of grease consistency to application.

### 8.1.6 Grease mixing

When different greases are mixed together, the consistency of the mixed grease varies (generally softens) so that the allowable operating temperature gets lower. To avoid such characteristic variation of grease, **it is not allowed to mix different greases, except mixing greases of same brand.**

Where mixing of different greases is inevitable, greases composed of thickener of same kind and similar base oil must be selected. Even when greases of same kind are mixed together, thus, 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.

Table 8.3 Grease consistency

| NLGI<br>consistency No. |                                                                                     | JIS (ASTM)<br>60-cycle mixed<br>grease consistency | Application                                       |
|-------------------------|-------------------------------------------------------------------------------------|----------------------------------------------------|---------------------------------------------------|
| 0                       | Soft                                                                                | 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                       | Hard                                                                                | 175~205                                            | Special application                               |

### 8.1.7 Grease fill amount

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

Around 50% to 80% of static spacing volume in bearing and housing is deemed as a guideline to the fill amount. In the case of high rotational speed, this fill amount must be set up a little bit less for controlling temperature rise to a low rate. **Too much fill amount of grease would cause the grease temperature to rise higher, 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.**

Further, for the machined ring needle roller bearing with inner ring the approximate value of spacing volume in the bearing can be determined by **formula (8.1)**.

$$V = 35W \quad \text{.....(8.1)}$$

where,

$V$  : Internal spacing volume (approximate value)  $\text{cm}^3$

$W$  : Bearing weight kg (See Dimensions Table)

### 8.1.8 Grease replenishment

Lubrication grease must be replenished at an proper interval because its lubrication performance deteriorates with elapse of the bearing running time. However, this replenishing interval differs depending on bearing type, dimension, rotational speed, bearing temperature, kind of grease used, etc.

**Fig.8.2** 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 the shorter 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.]** Determine the grease replenishing interval in the case when bearing **NA4910R** is in running under the conditions of radial load  $P_r$  5kN {510kgf} and rotational speed  $n$  1 600r/min.

$d = 50\text{mm}$ ,

$n_o = 4700$  is determined from NA4910R

$C_r = 48\text{kN}$  (4900kgf) and allowable rotational speed = 4,700 r/min in the Dimensions Table.

Accordingly,

$$\frac{n_o}{n} = \frac{4700}{1600} \div 2.9$$

Plot a line horizontally from  $d = 50$  point in **Fig. 8.2** and

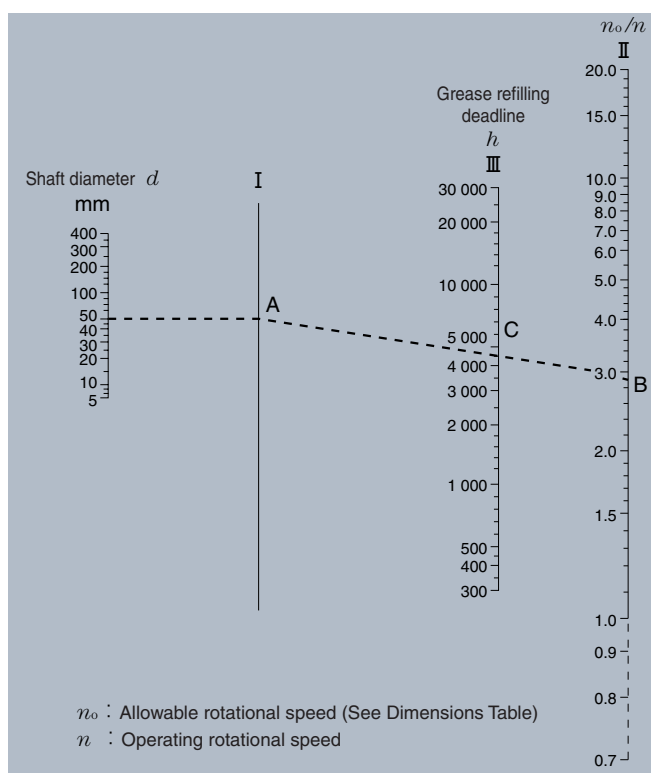


**Fig.8.2** Chart for determination of grease replenishing interval

deem the intersection point with the vertical line **I** as **A**. Thereafter, connect  $n_o/n=3$  point **B** on the vertical line **II** and said **A** point together, with a straight line, and determine the intersection point **C** with the vertical line **III**. And the grease replenishing interval of approximately 4600 hours can be read from the intersection point **C**.

## 8.2 Oil lubrication

In general, oil lubrication is more suitable for high speed running application or high temperature application than grease lubrication. Oil lubrication is suitable for the case where heat value generating from a bearing or heat value being transferred to a bearing must be discharged outside the bearing.

### 8.2.1 Lubrication method

#### (1) Oil bath lubrication

This oil bath lubrication is the most common of the currently available oil lubrication methods, which is applied to bearings running at low or medium speed. 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 in 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, and 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 and medium and less loads act on thereon. In this method, oil drips from an oiler provided on the top of a bearing unit strikes the rolling elements in its housing for atomizing lubrication (**Fig. 8.3**) or otherwise

a small amount of oil passes through the bearing. In many cases 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 automatically many lubricating portions by a centralized lubrication system. In more detail, as the features of this method the oil feed line is equipped with a cooler to cool down the lubrication oil and, in addition, provided with an oil filter to purify the lubrication oil.

Under this circulating lubrication system, the lubrication oil must securely 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.8.4)

#### (5) Others

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

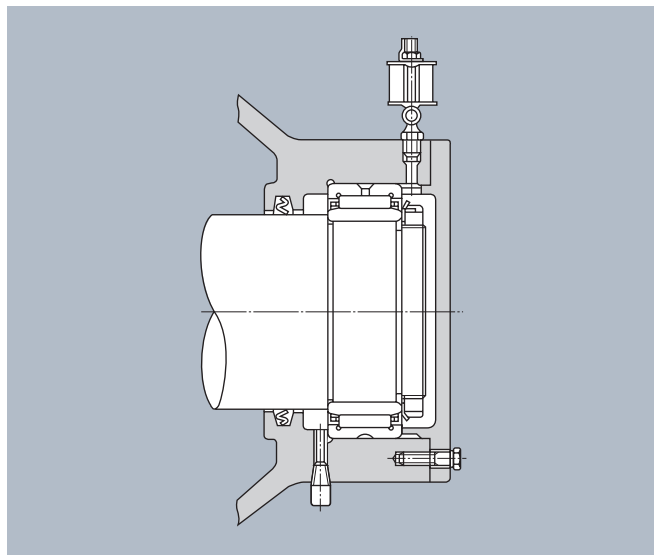


Fig. 8.3 Drip lubrication

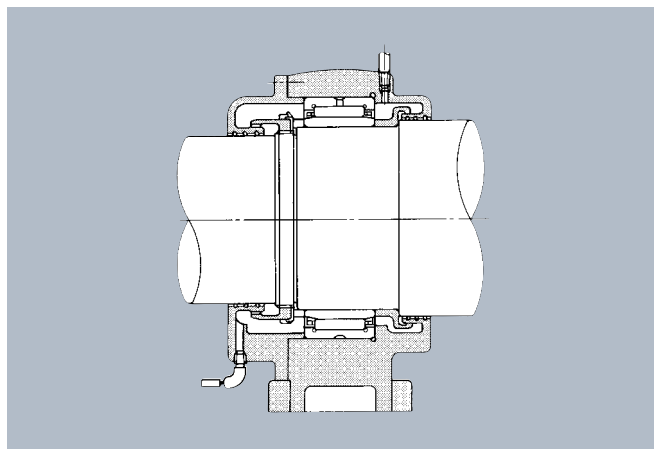


Fig.8.4 Circulating lubrication

#### 8.2.2 Lubrication oil

Mineral oils such as spindle oil, machine oil, turbine oil, etc. are mostly used as the lubrication oil for bearings. However, synthetic oils such as diester oil, silicone oil, fluorocarbon oil, etc. are used under the operating conditions wherein bearings are subjected to running at high temperature of 150°C and over or low temperature of -30°C and less.

For lubrication oil, its viscosity is one of the important characteristics that determine the lubrication performance. Too low viscosity of lubrication oil would cause imperfect forming of an oil film and finally cause damage of bearing surface, while too high viscosity of lubrication oil would cause great viscosity resistance, which would then lead 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 load.

Lubrication of bearings needs the oil viscosity every each operating temperature which is specified in **Table 8.4**. **Fig. 8.5** shows the lubrication oil viscosity - temperature characteristic chart, which is referred to in selecting a lubrication oil of optimal viscosity under actual operating temperature.

Furthermore, **Table 8.5** shows the criterion for selection of the lubrication oil viscosity according to the actual bearing operating conditions.

Table 8.4 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                                    |

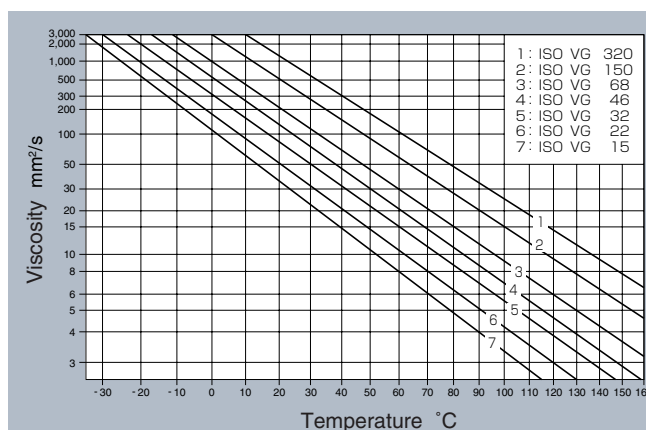


Fig. 8.5 Lubrication oil viscosity - temperature characteristic chart

Table 8.5 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.

### 8.2.3 Oil quantity

Under an forced oil lubrication system, heat value generating from bearing, etc. is equal to the sum of heat value radiated from housing and heat value carried away by lubrication oil.

Where a standard housing is used, the oil lubrication quantity as a guideline can be determined by **formula (8.2)**. The radiated heat value differs depending on the shape /profile of a housing used. It is therefore desirable to determine the lubrication quantity best-suited to an actual equipment by adjusting it from a value approximately 1.5 to 2 times as much as the lubrication rate determined by formula (8.2). In addition, Where the lubrication quantity is calculated assuming that the generated heat value is all carried away by the oil, with no heat radiation from the housing, the oil quantity  $q$  can be determined, assuming that the shaft diameter on 2nd vertical line from the right side in (Fig. 8.6) Chart for Determination of Oil Quantity  $q$  is  $d=0$ .

$$Q = K \cdot q \quad \text{.....(8.2)}$$

Where,

$Q$ : Oil quantity per bearing  $\text{cm}^3/\text{min}$

$K$ : Coefficient being determined by operating temperature rise of oil (**Table 8.6**)

$q$ : Oil quantity that can be determined from the chart  $\text{cm}^3/\text{min}$  (**Fig.8.6**)

### 8.2.4 Fresh oil refilling interval

Although it depends on actual operating conditions, oil quantity and the kind of lubrication oil used, the fresh oil refilling interval as a guideline is around one year where bearings are lubricated with oil of 50°C and lower temperature by the oil bath method and is at least 3 months where bearings are lubricated with oil of 80 to 100°C.

For an important equipment it is desirable to monitor periodically the lubrication performance, cleanliness deterioration, etc. of the lubrication oil in use and to specify the fresh oil refilling interval under the monitor data.

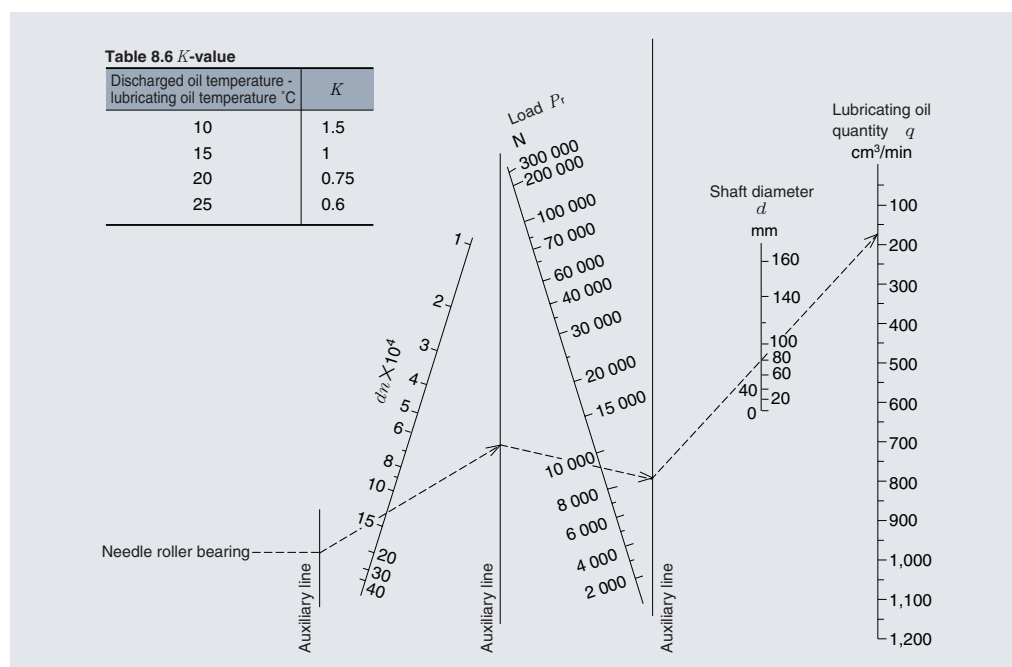


Fig. 8.6 Chart for determination of lubricating oil quantity

## 9. Sealing Devices

### 9.1 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 good care, under full consideration of the operating conditions,

lubricating condition, environmental condition, economical merit, etc., so that bearing running is not inversely affected by the sealing device.

The bearing seals are mainly classified into non-contact seal, contact seal, etc. as shown in **Tables 9.1** and **9.2**, which must then be selected correctly according to each application, under full consideration of the characteristics of each sealing type.

**Table 9.1 Seals (Non-contact seals)**

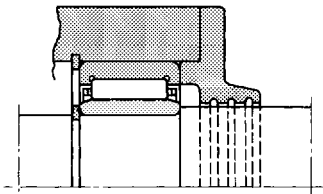
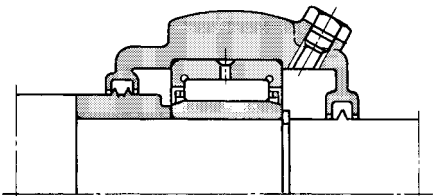
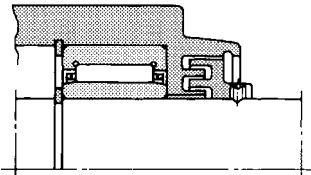
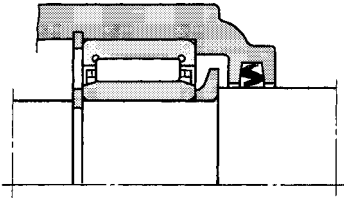
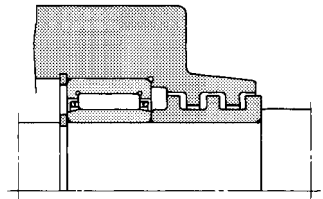
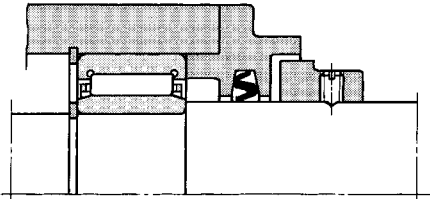
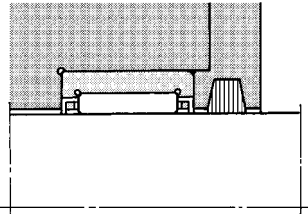
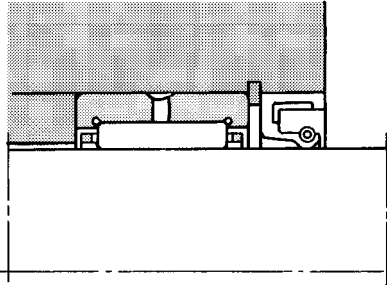
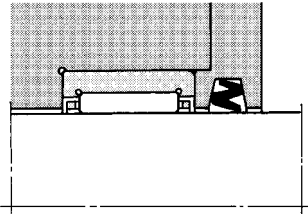
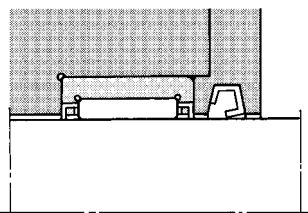
| Type                 | Non-contact seals                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                           |                              |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|                      | Seal type using a spacing                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Seal type using a centrifuge                                                                                                                                                                                                                                                              | Seal type using air pressure |
| Seal name            | Oil groove seal<br>Labyrinth seal (axial, radial)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Slinger seal                                                                                                                                                                                                                                                                              | Air seal                     |
| Features             | <p><b>&lt;Oil groove seal&gt;</b><br/>This seal is fitted at either one side of a housing or a shaft, or fitted at the both sides for sealing action. In this case, this seal has also an effect in preventing invasion of foreign matter from outside by holding grease in the oil groove.</p> <p><b>&lt; Labyrinth seal &gt;</b><br/>This seal having a high sealing effect due to its multi-stage labyrinths and long passage is mainly used for grease lubrication. Generally it is suited to high speed bearing running, 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 flown out along its sleeve by a centrifugal force if its sleeve is provided with projections.</p> <p>A seal example illustrated in <b>Fig. 9.6</b> prevents invasion of foreign matter from outside.</p> |                              |
| Application examples |  <p><b>Fig. 9.1 Oil groove seal</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  <p><b>Fig. 9.4 Slinger with projections</b></p>                                                                                                                                                      |                              |
|                      |  <p><b>Fig. 9.2 Axial labyrinth seal</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  <p><b>Fig. 9.5 Slinger intended for back flow of flown-out oil by centrifuge</b></p>                                                                                                                 |                              |
|                      |  <p><b>Fig. 9.3 Radial labyrinth seal</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  <p><b>Fig. 9.6 Slinger provided at outer side</b></p>                                                                                                                                                |                              |

Table 9.2 Seals (Contact seals)

| Seal type            | Contact seals                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      | Seal using mainly direct contact                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Seal using mainly fluid lubrication and boundary lubrication                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Seal name            | Seal ring (felt seal, etc.)<br>O-ring,<br>piston ring                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Oil seal,<br>V-shaped ring seal,<br>mechanical seal                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Features             | <p>This seal type seals a fluid perfectly by pressing its elastic body onto the sliding surface with a constant contact pressure. Generally the contact seals are more excellent in sealing performance than the non-contact seals, but the friction torque and temperature rise thereof are greater than those of the non-contact seals.</p> <p><b>&lt;Felt seal&gt;</b><br/>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 outflow are occasionally unavoidable to some extent.</p> | <p><b>&lt; Oil seal &gt;</b><br/>This seal type intended to seal lubricant at the sliding portion between its lip and a shaft has good sealing effect and is an effective seal in the most frequent use. 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 leak and dust-proofing individually.</p> |
| Application examples |  <p>Fig. 9.7 Felt seal</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  <p>Fig. 9.10 Oil seal</p>                                                                                                                                                                                                                                                                                                                                                                                                                    |
|                      |  <p>Fig. 9.8 Z type grease seal</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                      |  <p>Fig. 9.9 GS type grease seal</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

## 9.2 Combined seals

Several seal types are used in combination for a seal application under an environment where dust, water content, etc. exist so much or for mechanical portions which are not allowed to be contaminated by lubricant leak.

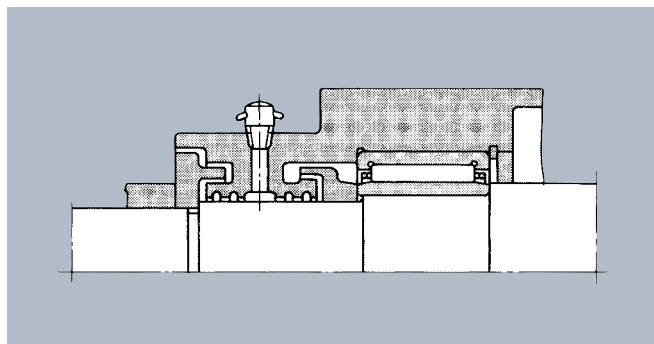


**Fig. 9.11 Combined non-contact seal**  
Combination of labyrinth seal and oil groove seal

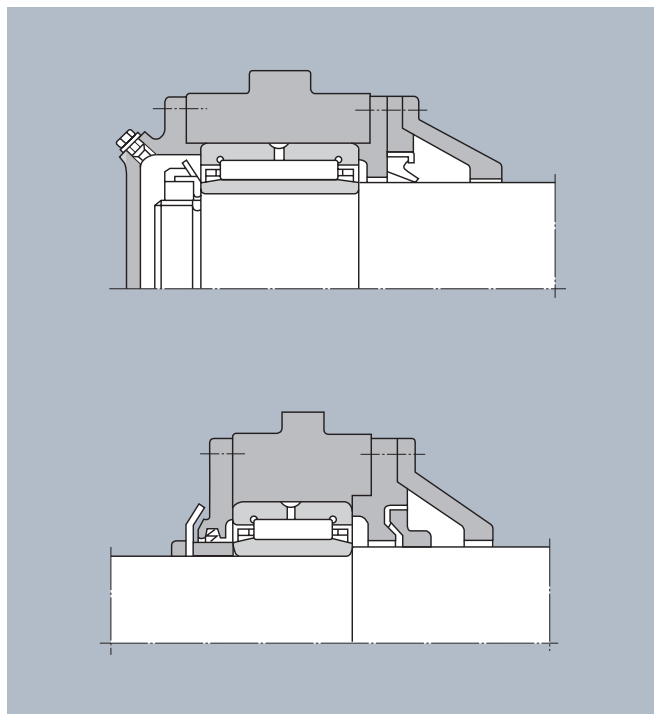


**Fig. 9.12 Combined seal**  
Combination of contact seal and non-contact seal

## 9.3 Clearance setting

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

**Table 9.3 Clearances**

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

## 9.4 NTN seals

Special-purposed NTN seals are available for the needle roller bearings. (Refer to **Table 9.4** on page A-48.) For the more detailed information refer to "Dimensions Table" on page B-233.

## 9.5 Seal materials and corresponding operating temperature ranges

The oil seal lip is ordinarily made of nitril rubber, but acrylic rubber, silicone rubber and fluoro-rubber are used as the lip material according to atmosphere temperature, an objective to be sealed, etc. **Table 9.5** shows the operating temperature ranges available for the respective materials.

**Table 9.5 Seal materials and corresponding operating temperature ranges (Reference)**

| Seal materials  | Operating temperature ranges °C |
|-----------------|---------------------------------|
| Nitril rubber   | -25~+100                        |
| Acrylic rubber  | -15~+130                        |
| Silicone rubber | -70~+150                        |
| Fluoro-rubber   | -30~+180                        |
| Felt            | -40~+120                        |

## 9.6 Seal types and allowable speed

The allowable speed for the contact seal type depends on the surface roughness, accuracy and lubrication property of sliding surface, operating temperature, etc. **Table 9.6** shows the allowable speed every each seal type, as a guideline.

**Table 9.6 Seal types and corresponding allowable speed (Reference)**

| Seal types               | Allowable peripheral speed m/s |
|--------------------------|--------------------------------|
| Felt seal                | 4                              |
| Grease seal              | 6                              |
| Oil seal (Nitril rubber) | 15                             |
| Oil seal (Fluoro-rubber) | 32                             |
| V-ring seal              | 40                             |

Table 9.4 Seals (NTN contact seals)

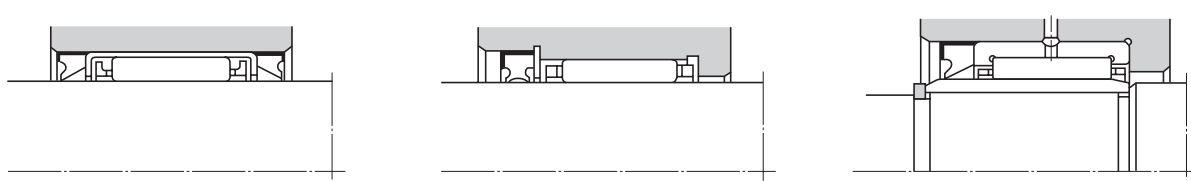
| Seal type            | Contact seals (G type, GD type)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|                      | Seal using mainly direct contact                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |
| Features             | <p>This seal type is a special-purposed seal for needle roller bearings which was designed for smaller section height so as to correspond flexibly to the said bearings.</p> <p>This is a synthetic rubber contact seal reinforced with steel plate, being then used in the operating temperature range of -25 to +120°C and, under continuous running condition, used at 100°C and less. For application under special operating conditions of over 120°C at operating temperature, etc., feel free to contact NTN for any inquiry.</p> |  |
| Application examples |                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |

Fig. 9.13 Bearing sealing by NTN seals (Example)

## 9.7 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 9.7** shows the surface roughness as a guideline. For improving better the wear resistance of shaft surface it is desirable to secure the shaft surface hardness at least at HRC40 and over (at HRC55 and over if possible) by heat treatment and hard chrome plating.

Table 9.7 Shaft surface hardness (Reference)

| Peripheral speed m/s |       | Surface roughness |
|----------------------|-------|-------------------|
| over                 | incl. | Ra                |
|                      | 5     | 0.8a              |
| 5                    | 10    | 0.4a              |
| 10                   |       | 0.2a              |



## 10. Bearing Handling

A rolling bearing is a precision part. It must be handled very carefully to keep its preciseness unchanged. Particularly the handling instructions given hereunder must be observed in handling.

### [1] Keeping bearing and other related parts clean

Foreign matters such as mist, dust, etc. would cause harmful affect on bearing running and life. To avoid such harmful effect, bearing and other parts mounted adjacent to the bearing must be kept clean and, in addition, handling tools, lubricant, washing oil, work environment, etc. must always be maintained in clean condition respectively.

### [2] Careful handling

Any shock to a bearing in handling would result in surface flaw and indent of its raceway surface and rolling elements and, in the worst case, result in cracking and chipping. To avoid such defects and trouble, bearings must be handled with good care.

### [3] Use of proper handling tools

It should be avoided to use another inappropriate tool as an alternative of the specific tool in installing and removing.

Specific tools suited to the individual bearing types must be used. The special-purposed handling tools must be used particularly when installing a drawn cup needle roller bearing.

### [4] Protection of bearing from rusting

A rust preventive oil is coated on all of bearings, as a rule. However, direct handling of bearings by the bare hands would cause rusting of the bearings from adhesion of hand sweat thereto. To protect bearings from rusting, a pair of gloves must be put on or otherwise mineral oil be coated on the hands in the case of direct handling by the bare hands.

### 10.1 Bearing storage

Bearings are all shipped after coated with rust inhibitor and packaged. It is desirable to store bearings at room temperature and relative humidity of 60% and less. The storage period of a grease-filled and sealed bearing is limited to the specific lifetime of non-greased bearing.

### 10.2 Installation

Although depending on bearing type and fitting conditions, the bearing installing methods described hereunder are selectively available as the general method. However, refer to Commentary given in the Dimensions Table for installation of the drawn cup needle roller bearings.

#### (1) Preparations prior to installing

For installation of bearings it is desirable to prepare a cleaned and dried work place.

Contaminant, burr, chips, etc. must be removed completely from all the parts related to a shaft and a housing before installing.

Furthermore, the bearing mount must be inspected to verify whether its dimensional accuracy, profile accuracy and surface roughness are within the respective specified tolerance ranges.

Bearings are all unpacked before installing. In the case of using bearings with grease lubrication, generally they may be installed as are without washing off the rust inhibitor coated thereon.

Where a bearing is used with oil lubrication or the lubricating function of a grease-lubricated bearing is impaired by a mixture of grease and rust inhibitor, however, the bearing must be installed after complete removal of the rust inhibitor by clean washing oil.

**It is not allowed to wash shield type and seal type bearings and one-way clutch.**

#### (2) Press-fit by a press machine

In general, the press-fit method using a press machine is widely used for installation of bearings. In detail, the bearing ring (inner ring or outer ring) is press-fitted slowly via a backing strip as illustrated in Fig. 10.1. **It is not allowed to apply the press force to a bearing via its rolling elements like a bad example illustrated in Fig. 10.2 (page A-50).**

Further, a small size bearing with small interference may be installed by hammering the bearing ring with a plastic hammer or the like. **In that case, however, the uniform hammering force must be applied to the bearing side face via the backing strip as illustrated in Fig. 10.1, because direct hammering to the bearing end face or partial hammering by use of a punch could impair the specific bearing performance.**

Fitting the inner ring on a shaft by hammering the outer ring or fitting the inner ring by hammering itself would result in surface flaw and indent of the raceway surface and the rolling elements. Therefore, doing so must be avoided absolutely.

Also, friction of the fitting surface can be reduced by coating high viscosity oil on the surface.

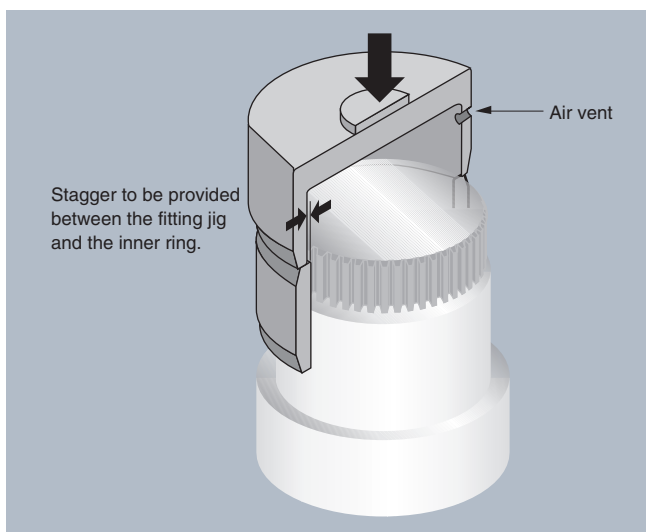


Fig. 10.1 Press-fitting of inner ring

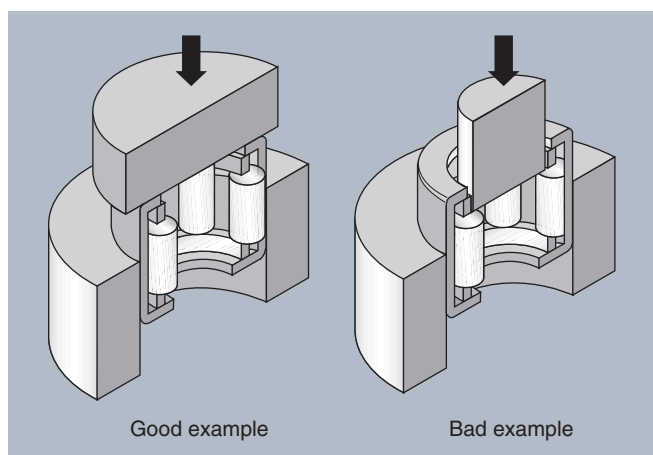


Fig.10.2 Press-fit

### (3) Shrinkage fit

This shrinkage fit method is to fit the inner ring on a shaft after dipping it in hot oil for thermal expansion of its bore. This method is also widely used for installation of bearings. In heating the inner ring, low-corrosive mineral oil or the like is used. In this case, the heated inner ring is natural-cooled down after shrinkage-fit, but simultaneously it shrinks in axial direction, too. Therefore, the inner ring must be pressed to the shaft shoulder until adequate cool-down, so as not to allow a clearance between the inner ring and the shoulder.

In any case, however, it is not allowed to heat the inner ring up to over 120°C.

Fig. 10.3 shows the relationship of inner ring bore thermal expansion to heating temperature.

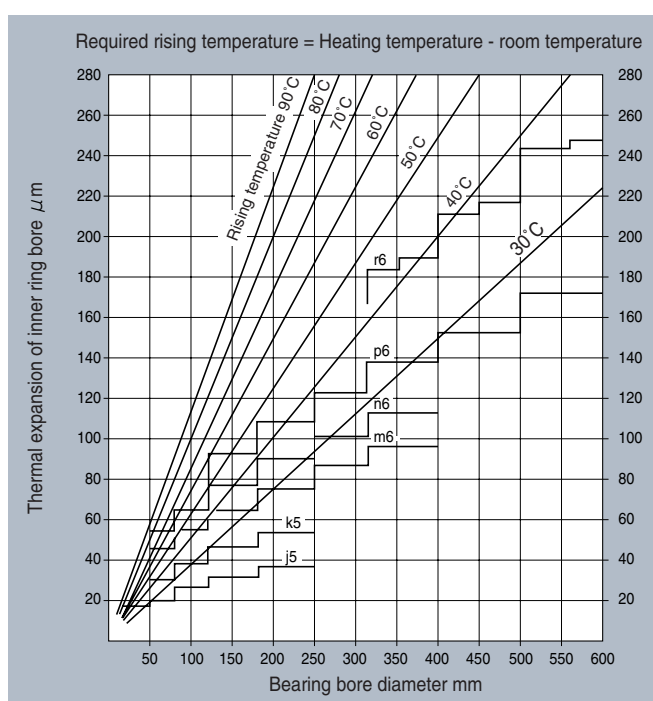


Fig. 10.3 Rising temperature required for shrinkage fit of inner ring

### 10.3 Post-installation running test

Bearing running test must be conducted on an installed bearing to check whether it was installed correctly. In this case, accelerating immediately the running speed up to the rated speed must be avoided absolutely. Doing so could result in damage of the bearing in the case of imperfect installation and seizure of the bearing in the case of inadequate lubrication. In testing, therefore, the shaft or the housing must first be rotated by hand and thereafter the shaft be rotated at low speed under no-load condition by the driving power, unless any failure is detected upon checking. After that, the running speed and load on the bearing must be accelerated and increased gradually while checking the running condition.

Running sound level and tone of a bearing can be checked by a sound scope held in contact with the bearing housing. The sound is normal if it is a pure sound upon checking. In this case, high metallic sound or irregular sound from the bearing, if any, reveals occurrence of somewhat failure. In such a case, possible cause of the failure can be presumed by measuring quantitatively vibration amplitude and frequency using a vibrometer.

Generally bearing temperature is presumed from the circumferential temperature of a housing. However, it can be judged more exactly if possible to measure directly the outer ring temperature by utilizing the oil hole thereof, etc.

Needless to say, bearing temperature rises with elapse of the running time and reaches a constant level after a certain time. Rapid bearing temperature rise or continued temperature rise in excess to the constant level or abnormally high bearing temperature would reveals occurrence of somewhat failure. In such a case, careful check is required.

Table 10.1 shows the required check items.

Table 10.1

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

### 10.4 Bearing removal (dismounting)

Some related bearings are removed from each shaft, incurred by periodic disassembly or incidental trouble of a machine. In this case, these bearings must be handled with good care similarly to the case of installation, when they are reused or the condition thereof is examined after removed (dismounted). Too tight fit of a bearing would incur difficulty in dismounting and, therefore, the bearing-related construction must be fully considered in design of

the bearing fixing method.

Regarding the dismounting method, generally the press method (**Fig. 10.4**) and the puller method (**Fig. 10.5**) are available for dismounting inner ring though depending on bearing type and fitting conditions.

When inner ring is dismounted from a shaft by heating, good care must be exercised not to over-heat the inner ring.

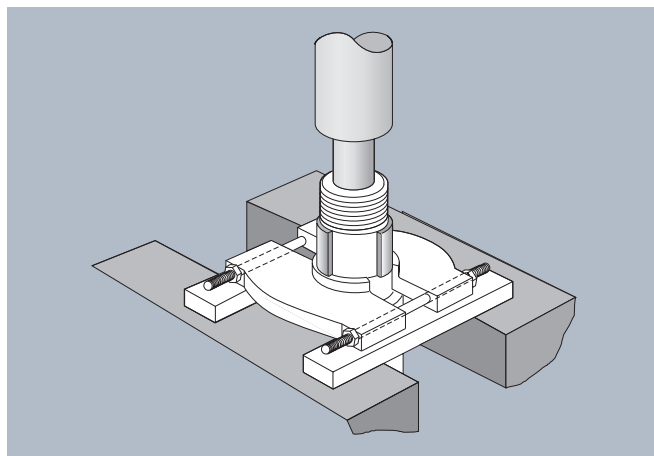


Fig. 10.4 Bearing removal by a press machine

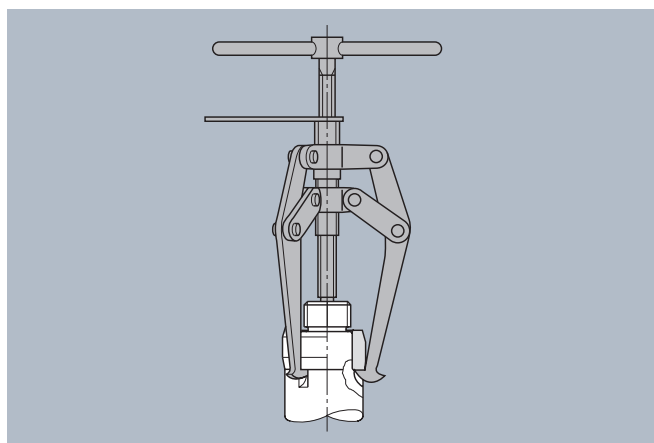


Fig. 10.5 Bearing removal by a puller

## 10.5 Force required for press-fit and pull-out

The force required for press-fitting or pulling out inner ring on / from a shaft can be determined by **formula (10.1)**.

$$K_a = f_K f_E \frac{d}{d+3} \Delta d_F \quad (10.1)$$

Where,

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

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

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

For pulling-out..... 60 (6)

$f_E$  : Coefficient depending on inner ring dimension

$$f_E = B \left[ 1 - \left( \frac{d}{F_1} \right)^2 \right]$$

$B$  : Inner ring width mm

$d$  : Inner ring bore diameter mm

$F_1$  : Mean outer diameter of inner ring mm

$\Delta d_F$  : Apparent interference  $\mu\text{m}$

Actual press-fit force and pull-out 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.

## 10.6 Washing

Rotating a bearing with foreign matter adhered thereto could result in damage of the raceway surface, etc.

Therefore, any dismounted bearing is usually washed by light oil or kerosene or the like for complete removal of foreign matter. In this case, two washing vessels must be used as follows; one for rough washing and another for finish washing. Rough washing is done for removal of oil and foreign matter from bearing, while finish washing is done for fine washing of the roughly-washed bearing.

Further, any vessels used for washing must be provided with a steel net as the middle bottom above the vessel bottom, as illustrated in **Fig. 10.6**, to prevent the bearing from coming in direct contact with the vessel bottom.

Furthermore, rust preventive treatment must be applied to the washed bearing immediately after washing, to thereby protect it from a risk of corrosion.

In addition, the legal requirements as applicable (environmental preservation, industrial labor safety and health, etc.) and the washing specification submitted from a detergent manufacturer must be taken in consideration in washing.

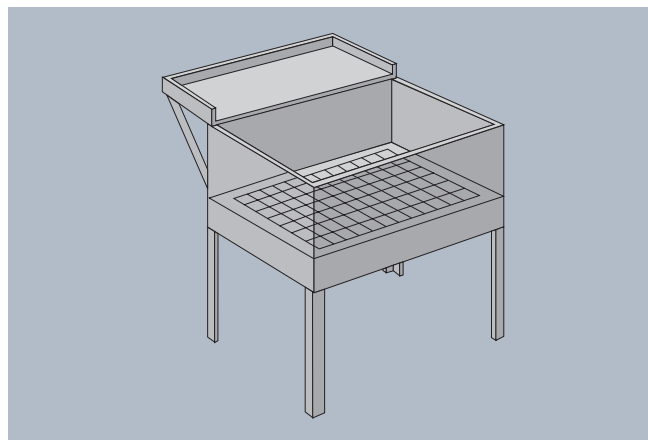


Fig. 10.6 Washing tank

## 11. Technical Data

### 11.1 HL Bearing

The form of bearing separation life can be mainly classified into the internal origin type and the surface origin type. Bearing separation of the surface origin type is said to occur in an inadequately lubricated area and it is widely recognized that the bearing separation life correlates to the oil film parameter that can be determined by "Elastic Fluid Lubrication Theory (EHL Theory)".

This oil film parameter must be increased for controlling the surface origin type separation and, for that, the bearing manufacturers have made possible effort for better improvement of lubricant and for upgrading of the bearing rolling raceway surface roughness.

In recent years it has been proposed by the relative field that the capability of forming an oil film on contact surfaces could be improved better by changing the form and directivity of surface roughness of machined parts.

On the other hand, NTN developed successfully long life HL (High Lubrication) bearings under "Micro EHL Theory" as one of the countermeasures against surface origin type separation. And these HL bearings have been widely used in each field since developed.

#### 11.1.1 Basic concept of HL bearing

**Fig. 11.1** illustrates the basic concept of the HL bearing.

In this Figure, the hatched area shows a contact portion deformed elastically and the dotted line shows the lubrication flow, based on "Internal lubrication fluid flow model in contact portion" disclosed by H.S. Cheng and others.

Lubricant flow in (B) has a resistance greater than that in (A). This means that the quantity of a fluid existing internally in the contact portion increases. In other words, the thickness of an oil film formed on the rolling contact surface increases with increase of the fluid quantity.

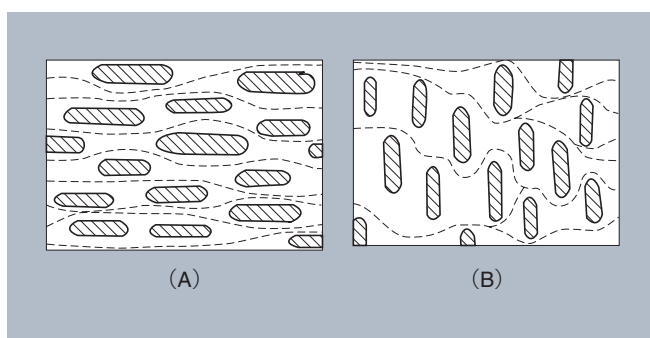


**Fig. 11.1** Directivity of finished surface and lubrication fluid flow model

#### 11.1.2 HL surface

**Fig. 11.2** is a magnified photo showing roller surface. In this Figure the blackened spots are micro recessed spots and, as seen from this Figure, a number of micro oil pots of around several tens  $\mu\text{m}$  exist at random. The recessed spots on this surface can be modified into any optional size and the number of spots by changing the machining conditions. **Fig. 11.3** shows the bus line form of the HL surface, from which the depth of the micro recessed spots is nearly  $1\text{ }\mu\text{m}$ .

#### 11.1.3 HL bearing application examples

The HL surface-treated bearings are widely used in various fields. For example, they are used for car transmission, hydraulic devices, various reduction gears, etc.

As an example of special application, HL surface treatment is applied to the special-purposed bearing for the rocker arm of car engine. This is highly appreciated as an effective seizure preventive measure.

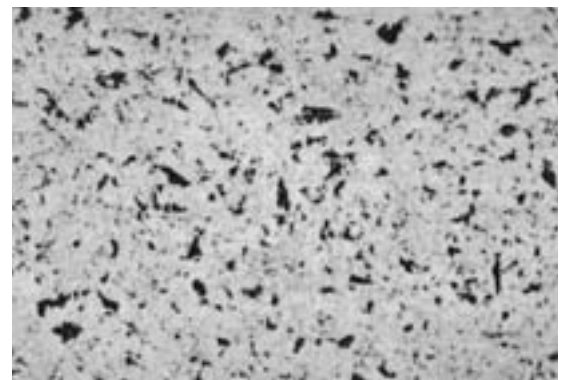


**Fig. 11.2** Magnified photo showing roller surface

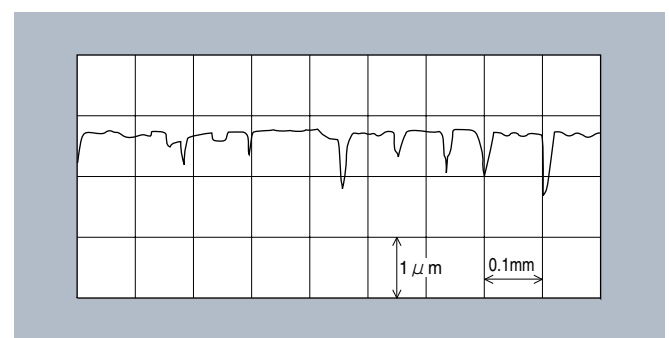


**Fig. 11.3** Bus line form of HL surface

## 11.2 Bearings with Solid Grease

Bearings with Solid Grease means a bearing in which thermal solidification type grease (mainly composed of lubrication grease and resin) is filled as a lubricant material.

Once this thermal solidification type grease (referred to as Bearings with Solid Grease) was heated and cooled down (hereinafter referred to "heat treatment"), the paste-like grease hardens as much lubricant held unchanged.

The Bearings with Solid Grease is solidified after heat treatment so that the lubricant does not leak easily even in the case wide amplitude vibration and strong centrifuge act on the bearing, thus contributing to prevention of lubricant leak and longer bearing life.

The spot pack specification in which Bearings with Solid Grease was packed at multiple points on the cage and the full pack specification in which Bearings with Solid Grease was nearly full-packed in the spacing volume of bearing are both available for the Bearings with Solid Grease. Further, the needle roller bearings are all based on the full pack specification.

### 11.2.1 Characteristics of Bearings with Solid Grease

#### (1) Less lubricant leak

Bearings with Solid Grease holds much lubricant internally in bearing because it is solidified after heat treatment. This lubricant is gradually fed onto the rolling surface by heat generating from the bearing and centrifuge, whereby lubricant leak is minimized. This serves to prevent the peripheral environment from being contaminated, comparing with general lubrication greases.

#### (2) Good lubricating characteristic

Even when wide amplitude vibration and strong centrifuge act on a bearing, lubricant does not leak easily and, in addition, Bearings with Solid Grease does not emulsify and flow out easily, because of its solid type, even in the case of water content inflow to bearing.

Thus, the lubricating characteristic is more excellent than general lubrication greases.

#### (3) Sealing effect

Bearings with Solid Grease acts as a preventive barrier against foreign matters (water content, dust, etc.) invading from outside, but does not function perfectly as a seal. Therefore, use of the contact type rubber seal (for deep groove ball bearing, bearing unit) or another seal (for other bearings) is recommended particularly when high sealing performance is required.

### 11.2.2 Attentive points in using Bearings with Solid Grease

- (1) The needle roller bearing dimension to accept Bearings with Solid Grease differs every each bearing type. Feel free to contact NTN for the detail.
- (2) The allowable temperature range is -20°C to 80°C, but 60°C and less for continuous long term running. Fully note the operating temperature.
- (3) Allowable rotational speed  $F_w \cdot n$  value ( $F_w$  = inscribed circle diameter [mm])  $\times$  ( $n$  = operating rotational speed [r/min]) is differs from that in use of general grease and lubrication oil. Fully note this matter.  
Use any needle roller bearings on  $F_w \cdot n$  value = 30,000 and less.
- (4) For the bearings of the full pack specification, minimum load equivalent to at least around 1% of the basic dynamic load rating is needed for enabling the rolling elements to run without slipping.
- (5) Bearings with Solid Grease acts as a preventive barrier against foreign matter invading from outside, but does not function perfectly as a seal. Therefore, combined use of Bearings with Solid Grease and rubber seal is recommended particularly when high sealing performance is required.

### 11.2.3 Application examples of Bearings with Solid Grease bearings

- 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 two-wheeled car
- 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





## 11.3 Calculation Examples

### 11.3.1 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-33. 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.

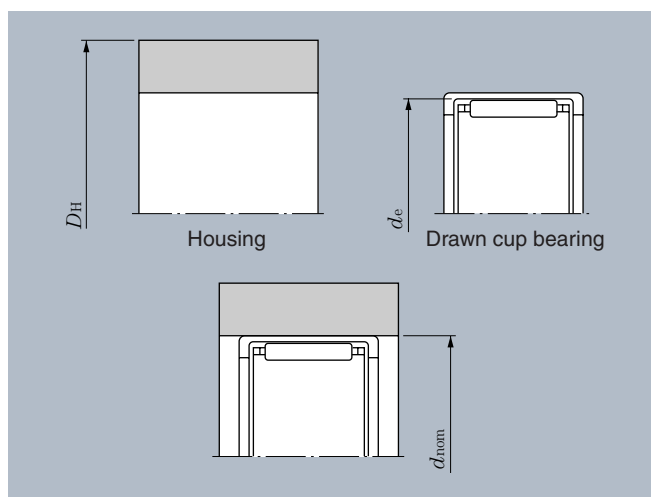


Fig. 11.4

$$\lambda = \frac{2t}{E_2} \cdot \frac{1-S^2}{\frac{(0.7S^2+1.3)(1-t^2)}{E_1} + \frac{(0.7+1.3t^2)(1-S^2)}{E_2}} \quad \cdots(11.1)$$

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

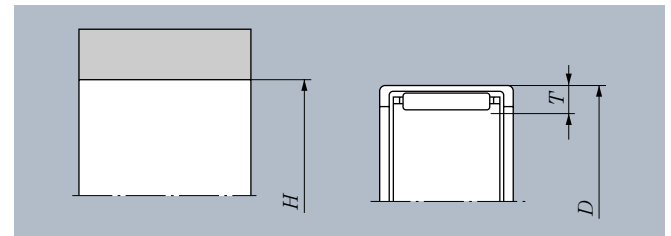


Fig. 11.5

- $H$  : 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.

$$L_i = D - 2T - \lambda(D - H) = (1 - \lambda)D - 2T + \lambda H \quad \cdots(11.2)$$

Determine the mean value of "roller diameter + plate thickness" ( $=T$ ) and standard deviation from formula (11.2). The mean value of formula (11.2) is determined as follows.

$$m_{Li} = (1 - \lambda)m_D - m_{2T} + \lambda m_H \quad \cdots(11.3)$$

Standard deviation of formula (11.2)

$$\sigma_{Li2} = (1 - \lambda)_2 \cdot \sigma_{D2} + \sigma_{2T2} + \lambda_2 \sigma_{H2} \quad \cdots(11.4)$$

In the case of master ring, due to  $\sigma_{H2}=0$  the formula (11.4) is expressed as follows.

$$\sigma_{Li2} = (1 - \lambda)_2 \cdot \sigma_{D2} + \sigma_{2T2} \quad \cdots(11.5)$$

The unknown values in formulas (11.3), (11.5) are only  $m_{2T}$  and  $\sigma_{2T2}$ . Hence, substitute the known numerical values for formulas (11.3), (11.5) to determine  $m_{2T}$  and  $\sigma_{2T2}$ .

[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 (11.3), (11.4) by adding " ' " to each formula.

$$m_{Li'} = (1 - \lambda')m_D - m_{2T'} + \lambda'm_H \quad \cdots(11.6)$$

$$\sigma_{Li'2} = (1 - \lambda')_2 \cdot \sigma_{D2} + \sigma_{2T'2} + \lambda'_2 \sigma_{H'2} \quad \cdots(11.7)$$

[3] For  $m_{2T}$  and  $\sigma_{2T2}$  in formula (11.6), (11.7), 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**

$$L_i' = m_{Li}' \pm 3 \sigma_{Li}' \quad \dots\dots\dots (11.8)$$

[5] Radial internal clearance can be determined considering the mean value and standard deviation of shaft in **formulas (11.6), (11.7)**.

[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.

### 11.3.2 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 numerical value under JIS Z8413 Revised Conversion Table)

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 strength of the follower material increases with increase of its hardness, and the track load capacity of the follower increases incurred by increase of the tensile strength strength. In this case, the load capacity increase rate can be determined by multiplying the track load capacity by applicable track load capacity adjustment factor shown in **Table 11.1**.

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 NATR15X,

$$\begin{aligned} T_c &= 11\,900\text{N} \text{ (1\,220kgf)}, \quad G = 1.987 \\ \therefore T_c' &= 1.987 \times 11\,900\text{N} \text{ (1\,220kgf)} \\ &= 23\,645\text{N} \text{ (2\,424kgf)} \end{aligned}$$

#### Reference (Track load capacity calculation process)

- For a cylindrical outer ring

$$\sigma_{\max} = \frac{1}{60.9} \sqrt{\frac{T_c \Sigma \rho}{B_{\text{eff}}}}$$

- For spherical R outer

$$\sigma_{\max} = \frac{187}{\mu \nu} \sqrt[3]{(\Sigma \rho)^2 T_c}$$

$$\sigma_{\max} = 1\,245\text{MPa} \text{ (127kgf/mm}^2\text{)}$$

$T_c$  : 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 11.1 Track load capacity adjustment factor**

| Hardness<br>HRC | Tensile strength<br>MPa {kgf/mm <sup>2</sup> } | Adjustment factor $G$      |                            |
|-----------------|------------------------------------------------|----------------------------|----------------------------|
|                 |                                                | for cylindrical outer ring | for spherical R 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                      |

### 11.3.3 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. 11.6**. In this case, the outer ring rupture strength means the bridged rupture strength of roller.

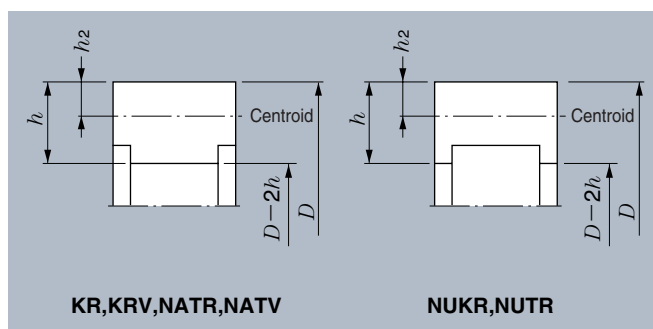


Fig. 11.6

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.

$$P = \frac{4\pi}{1+f(\alpha)} \times \frac{D-2h}{h(D-2h)^2} \times I \times \sigma$$

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. 11.6** (mm)

### 11.3.4 Stud strength of cam follower

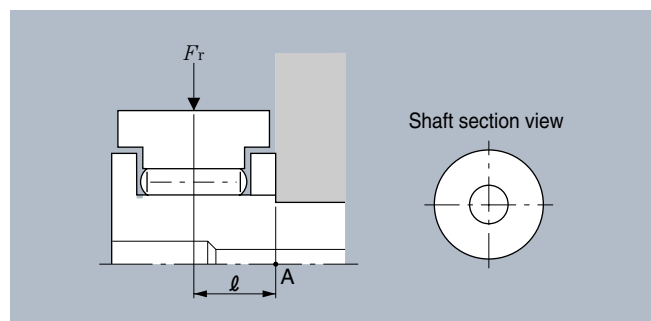


Fig. 11.7

When load  $F_r$  acts on the center point of outer ring as illustrated in **Fig.11.7**, bending moment  $F_r \cdot l$  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.

$$\sigma_1 + \sigma_2 < \sigma$$

$$\sigma_1 = \frac{F_r \cdot l}{Z} \quad \begin{array}{l} F_r : \text{Maximum radial load} \\ Z : \text{Coefficient of shaft section through Point-A} \end{array}$$

$$\sigma_2 \doteq 98 \text{MPa (10kgf/mm}^2\text{)}$$

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,

$$F_r < \frac{Z}{l} (\sigma - \sigma_2)$$

## 12. Bearing Type Symbols and Auxiliary Symbols

Table 12.1 Bearing Type Symbols

| Type code | Bearing type                                                                  |
|-----------|-------------------------------------------------------------------------------|
| 811       | Single-direction thrust cylindrical roller bearing, dimension series 11       |
| 812       | Single-direction thrust cylindrical roller bearing, dimension series 12       |
| 893       | Single-direction thrust cylindrical roller bearing, dimension series 93       |
| A         | Needle roller, spherical type                                                 |
| AS11      | Steel plate thrust washer, dimension series 11                                |
| ARN       | Needle roller bearing with double-direction thrust cylindrical roller bearing |
| AXK11     | Thrust needle roller bearing, dimension series 11                             |
| AXN       | Needle roller bearing with double-direction thrust needle roller bearing      |
| BF        | Metallic flat cage for linear flat rollers                                    |
| BK        | Drawn cup needle roller bearing with close end                                |
| BR        | Snap ring for bearing housing                                                 |
| CRV       | Full complement roller for cam follower,                                      |
| DCL       | inch series                                                                   |
|           | Drawn cup needle roller bearing with open end, inch series                    |
| F         | Needle roller, plane type                                                     |
| FF        | Linear flat roller                                                            |
| FR        | Bottom roller, for drawing frame (textile machine)                            |
| FRIS      | Bottom roller                                                                 |
| G         | Synthetic rubber seal, one-lip type                                           |
| GD        | Synthetic rubber seal, double-lip type                                        |
| GK        | Needle rollers with split type cage                                           |
| GS811     | Outer ring for thrust bearing, dimension series 11                            |
| GS812     | Outer ring for thrust bearing, dimension series 12                            |
| GS893     | Outer ring for thrust bearing, dimension series 93                            |
| HCK       | Drawn cup needle roller bearing for cross joint                               |
| HF        | One-way clutch                                                                |
| HFL       | One-way clutch integral with bearing                                          |
| HK        | Drawn cup needle roller bearing with open end                                 |
| HMK       | Drawn cup needle roller bearing with open end, for heavy load application     |
| IR        | Inner ring                                                                    |
| JF··S     | Arms for tension pulley and jockey pulley                                     |
| JPU··S    | Tension pulley and jockey pulley                                              |
| K         | Needle rollers with cage                                                      |
| K811      | Thrust cylindrical roller, dimension series 11                                |
| K812      | Thrust cylindrical roller, dimension series 12                                |
| K893      | Thrust cylindrical roller, dimension series 93                                |
| KBK       | Needle roller and cage assembly for small ends                                |
| KD        | Linear ball bearing, stroking type                                            |
| KH        | Linear ball bearing, drawn cup type                                           |
| KLM       | Linear ball bearing, machined ring type                                       |
| KLM··S    | Linear ball bearing, clearance-adjustable type                                |
| KLM··P    | Linear ball bearing, open type                                                |
| KR        | Cam follower                                                                  |
| KRU       | Cam follower, shaft eccentric type                                            |
| KRV       | Cam follower, full complement roller type                                     |
| KRVU      | Cam follower, full complement roller and shaft eccentric type                 |

| Type code | Bearing type                                                                                           |
|-----------|--------------------------------------------------------------------------------------------------------|
| MI        | Inner ring, inch series                                                                                |
| MR        | Machined ring needle roller bearing without inner ring, inch series                                    |
| NA22      | Roller follower with inner ring, dimension series 22                                                   |
| NA48      | Machined ring needle roller bearing with inner ring, dimension series 48                               |
| NA49      | Machined ring needle roller bearing with inner ring, dimension series 49                               |
| NA59      | Machined ring needle roller bearing with inner ring, dimension series 59                               |
| NA69      | Machined ring needle roller bearing with inner ring, dimension series 69                               |
| NA49··S   | Clearance-adjustable needle roller bearing with inner ring                                             |
| NAO       | Machined ring needle roller bearing, separable type, with inner ring                                   |
| NATR      | Roller follower                                                                                        |
| NATV      | Roller follower, full complement roller type                                                           |
| NIP       | Grease nipple                                                                                          |
| NK        | Machined ring needle roller bearing without inner ring                                                 |
| NKIA59    | Complex bearing : Needle roller bearing with angular ball bearing dimension series 59 Complex bearing  |
| NKIB59    | Needle roller bearing with three-point contact type ball bearing dimension series 59                   |
| NKX       | Complex bearing : needle roller bearing with thrust ball bearing without dust-proof cover              |
| NKX··Z    | Complex bearing: Needle roller bearing with thrust ball bearing with dust-proof cover                  |
| NKXR      | Complex bearing: Needle roller bearing with thrust cylindrical roller bearing without dust-proof cover |
| NKXR··Z   | Complex bearing: Needle roller bearing with thrust cylindrical roller bearing with dust-proof cover    |
| NUKR      | Cam follower, full complement roller type                                                              |
| NUTR2     | Roller follower, diameter series 2                                                                     |
| NUTR33    | Roller follower, diameter series 3                                                                     |
| NUTW      | Roller follower outer ring, middle rib type                                                            |
| PK        | Needle roller and cage assembly                                                                        |
| RF        | Polyamide resin cage for linear flat rollers                                                           |
| RLM       | Linear roller bearing                                                                                  |
| RNA22     | Roller follower without inner ring, dimension series 22                                                |
| RNA48     | Machined ring needle roller bearing without inner ring, dimension series 48                            |
| RNA49     | Machined ring needle roller bearing without inner ring, dimension series 49                            |
| RNA59     | Machined ring needle roller bearing without inner ring, dimension series 59                            |
| RNA69     | Machined ring needle roller bearing without inner ring, dimension series 69                            |
| RNA49··S  | Clearance-adjustable needle roller bearing, without inner ring                                         |
| RNAB2     | Open type roller follower without inner ring, diameter series 2                                        |
| RNAO      | Machined ring needle roller bearing, separable type, without inner ring                                |
| WR        | Snap ring for shaft                                                                                    |
| WS811     | Thrust inner ring, dimension series 11                                                                 |
| WS812     | Thrust inner ring, dimension series 12                                                                 |
| WS893     | Thrust inner ring, dimension series 93                                                                 |

Table 1.2.2 Auxiliary symbols

| Symbol          |                                 | Symbol representation                                                                                                                                                                                                                                                            |
|-----------------|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Initial symbols | Material heat-treatment symbols | TS- Bearing for high temperature application which was heat-treated for dimensional stabilization<br>M- Plated bearing<br>E- Bearing made of case-hardened steel<br>F- Bearing made of stainless steel<br>H- Bearing made of high speed steel<br>C- Bearing made of carbon steel |
|                 | Expansion compensation          | EC- Expansion-compensated bearing                                                                                                                                                                                                                                                |
| Basic symbols   |                                 |                                                                                                                                                                                                                                                                                  |
| Tail codes      | Internal construction symbols   | ZW Double-row cage<br>A,B,C Internal construction change                                                                                                                                                                                                                         |
|                 | Cage symbols                    | J Steel plate punched cage<br>F1 Machined iron cage<br>L1 High-strength yellow copper cage<br>T2 Polyamide resin cage<br>L3 Aluminum alloy cage<br>L5 Sintered alloy cage<br>S Welded cage                                                                                       |
|                 | Seal symbols                    | L,LL With synthetic rubber seal<br>P,PP With plastic seal                                                                                                                                                                                                                        |
|                 | Bearing ring profile symbols    | K Bearing with 1/12 tapered bore<br>N Grooved snap ring<br>NR With snap ring<br>W Bearing ring with notched knock hole<br>D With oil hole<br>D1 With oil hole and oil groove<br>H Cam follower with hexagon hole                                                                 |
|                 | Combination symbols             | D2,Dn Complex bearing using two or more same bearings<br>+ $\alpha$ With spacer<br>-P Without cross roller stud                                                                                                                                                                  |
|                 | Clearance symbols               | C2 Clearance smaller than ordinary clearance<br>C3 Clearance larger than ordinary clearance<br>C4 Radial clearance larger than C3<br>NA Non-interchangeable clearance                                                                                                            |
|                 | Accuracy class symbols          | P6 Bearing of JIS Class-6<br>P5 Bearing of JIS Class-5<br>P4 Bearing of JIS Class-4                                                                                                                                                                                              |
|                 | Lubrication symbols             | /2A SHELL ALVANIA Grease 2<br>/3A SHELL ALVANIA Grease 3                                                                                                                                                                                                                         |
|                 | Special symbols                 | V1~Vn Special specification, requirements                                                                                                                                                                                                                                        |

## Needle Roller Bearings

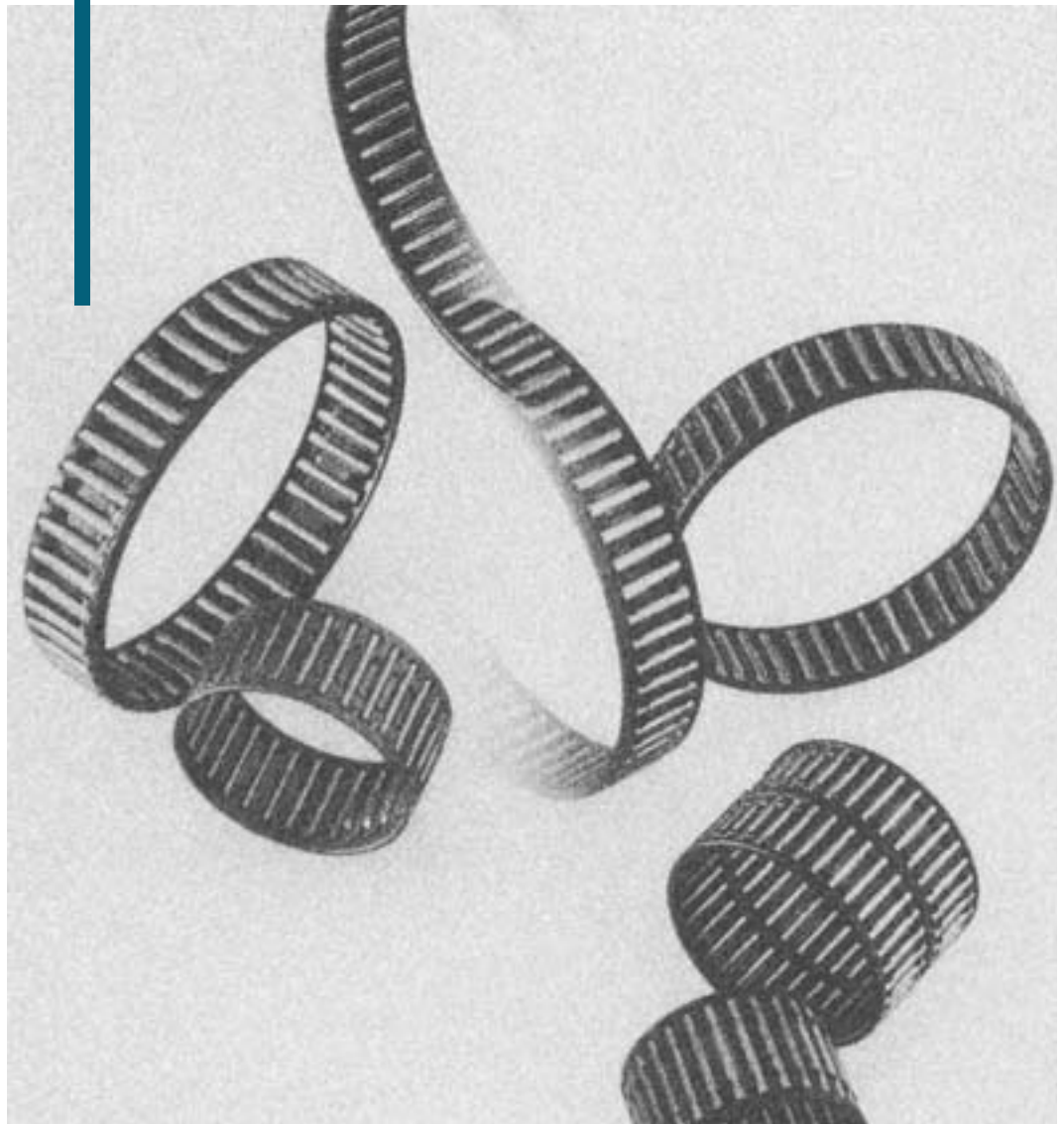
### *BEARING TABLES*

|                                                                                       |           |
|---------------------------------------------------------------------------------------|-----------|
| Needle roller and cage assemblies                                                     | B- 3～ 20  |
| Needle roller and cage assemblies<br>for connecting rod bearings                      | B- 21～ 28 |
| Drawn cup needle roller bearings                                                      | B- 29～ 52 |
| Machined-ring needle roller bearings                                                  | B- 53～ 96 |
| Machined-ring needle roller bearings,<br>separable                                    | B- 97～114 |
| Inner rings                                                                           | B-115～132 |
| Clearance-adjustable needle roller bearings                                           | B-133～138 |
| Complex bearings                                                                      | B-139～160 |
| Roller followers                                                                      | B-161～173 |
| Cam followers                                                                         | B-174～204 |
| Thrust roller bearings                                                                | B-205～220 |
| Components<br>Needle rollers / Snap rings / Seals                                     | B-221～234 |
| Linear bearings                                                                       | B-235～254 |
| One-way clutches                                                                      | B-255～259 |
| Bottom roller bearings for textile machinery<br>Tension pulleys for textile machinery | B-260～266 |





## Needle Roller and Cage Assemblies

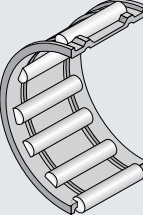
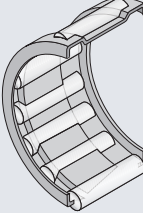
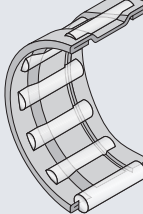
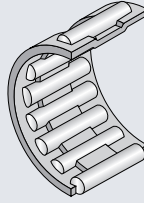
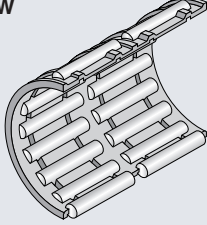
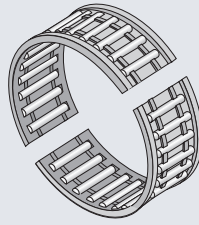


## Needle Roller and Cage Assemblies

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                                  | Applied shaft diameter (mm) | Composition of nominal bearing number                                                                                 | Nominal bearing number | Code items and respective dimensions                                                                                 |
|-----------------------------------------------------------------------------------------------------------------------|--------------------------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------|------------------------|----------------------------------------------------------------------------------------------------------------------|
| <b>K</b><br>(K··S)<br>(K··T2)<br>    | Machined ring type<br>Polyamide resin type | $\phi 3 \sim \phi 285$      | <b>K 20 × 24 × 10 S</b><br>Tail code<br>Width<br>Roller set outer diameter<br>Inscribed circle diameter<br>Type code  | K20×24×10S             | Inscribed circle diameter : $\phi 20$<br>Roller set outer diameter : $\phi 24$<br>Width : 10<br>S : Welded type      |
|                                                                                                                       | Welded type                                | $\phi 10 \sim \phi 100$     |                                                                                                                       |                        |                                                                                                                      |
| <b>KMJ</b><br>(KMJ··S)<br>(PCJ)<br> | Punched type                               | $\phi 15 \sim \phi 100$     | <b>KMJ 20 × 26 × 13</b><br>Width<br>Roller set outer diameter<br>Inscribed circle diameter<br>Type code               | KMJ20×26×13            | Inscribed circle diameter : $\phi 20$<br>Roller set outer diameter : $\phi 26$<br>Width : 13                         |
|                                                                                                                       | Welded type                                | $\phi 10 \sim \phi 40$      |                                                                                                                       |                        |                                                                                                                      |
| <b>KJ··S</b><br>                   | Welded type                                | $\phi 20 \sim \phi 40$      | <b>KJ 30 × 35 × 17 S</b><br>Tail code<br>Width<br>Roller set outer diameter<br>Inscribed circle diameter<br>Type code | KJ30×35×17S            | Inscribed circle diameter : $\phi 30$<br>Roller set outer diameter : $\phi 35$<br>Width : 17<br>S : Welded type      |
| <b>KV··S</b><br>                   | Welded type                                | $\phi 7 \sim \phi 100$      | <b>KV 30 × 35 × 17 S</b><br>Tail code<br>Width<br>Roller set outer diameter<br>Inscribed circle diameter<br>Type code | KV30×35×17S            | Inscribed circle diameter : $\phi 30$<br>Roller set outer diameter : $\phi 35$<br>Width : 17<br>S : Welded type      |
| <b>K··ZW</b><br>                   | Machined ring type                         | $\phi 8 \sim \phi 285$      | <b>K 20 × 24 × 45 ZW</b><br>Tail code<br>Width<br>Roller set outer diameter<br>Inscribed circle diameter<br>Type code | K20×24×45ZW            | Inscribed circle diameter : $\phi 20$<br>Roller set outer diameter : $\phi 24$<br>Width : 45<br>ZW : Double-row type |
| <b>GK</b><br>                      | Machined ring type<br>Split type           | $\phi 8 \sim \phi 285$      | <b>GK 30 × 35 × 17</b><br>Width<br>Roller set outer diameter<br>Inscribed circle diameter<br>Type code                | GK30×35×17             | Inscribed circle diameter : $\phi 30$<br>Roller set outer diameter : $\phi 35$<br>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 Demention Table.

## Inter-roller diameter deviation of needle rollers

Inter-roller diameter deviation of needle rollers which are built in one cage is within 2 $\mu$ m. The respective specified diameter tolerances 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.

Where two or more bearings are used 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 roller bearings

| Identification color on label | Diameter tolerance $\mu$ m | Classification |
|-------------------------------|----------------------------|----------------|
| 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               |                |

## 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 |                                 | $\sim$ 80 | 80 $\sim$ 140 | 140 $\sim$ |
|-------------------|---------------------------------|-----------|---------------|------------|
| Radial clearance  | Smaller than ordinary clearance | j5/G6     | h5/G6         | h5/G6      |
|                   | Ordinary clearance              | h5/G6     | g5/G6         | f5/H6      |
|                   | Larger than ordinary clearance  | g6/G6     | f6/G6         | 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

| Characteristics               | Shaft                                   | Housing |
|-------------------------------|-----------------------------------------|---------|
| Roundness (max)               | IT3                                     | IT4     |
| Cylindricity (max)            | IT3                                     | IT4     |
| Surface roughness (max)       | Refer to <b>Table 7.4</b> on page A-39. |         |
| Surface hardness              | HRC58 $\sim$ 64                         |         |
| Depth of hardened layer (min) | Refer to formula (7.1) on page A-39     |         |

## 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 tolerances

Unit : mm

| Classification | Tolerances for guide width $\bar{b}$                     |                                                          |
|----------------|----------------------------------------------------------|----------------------------------------------------------|
|                | 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    | $B_c \begin{smallmatrix} +0.4 \\ +0.2 \end{smallmatrix}$ | $B_c \begin{smallmatrix} +0.5 \\ +0.3 \end{smallmatrix}$ |

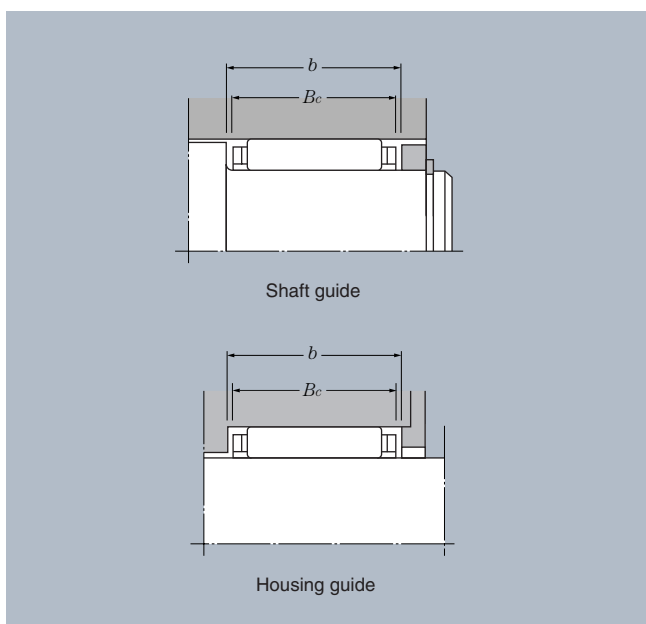
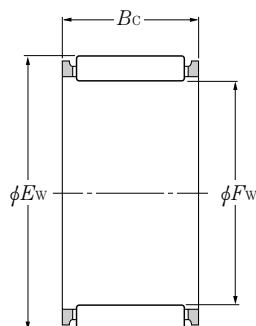
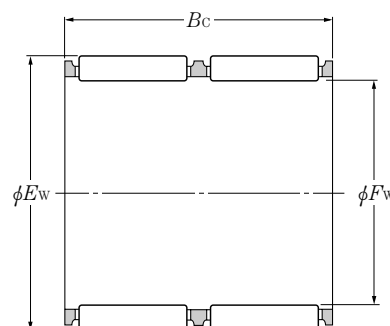


**Fig. 1**

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



Type K  
Type K··T2  
Type K··S

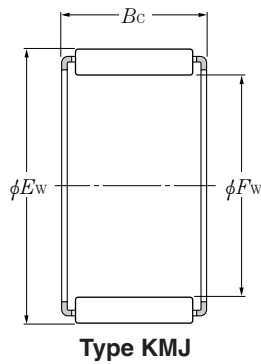


Type K··ZW

$F_w$  3~12mm

| Boundary dimensions |       |                              | Basic load ratings |          |         |          | Limiting speeds |        | Bearing numbers | Mass      |
|---------------------|-------|------------------------------|--------------------|----------|---------|----------|-----------------|--------|-----------------|-----------|
| mm                  |       |                              | dynamic            | static   | dynamic | static   | r/min           |        |                 | kg        |
| $F_w$               | $E_w$ | $B_c$                        | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ | grease          | oil    |                 | (approx.) |
| 3                   | 6     | 7 <sup>-0.2<br/>-0.55</sup>  | 1 460              | 970      | 149     | 99       | 33 000          | 50 000 | K3×6×7T2        | 0.0004    |
| 4                   | 7     | 7 <sup>-0.2<br/>-0.55</sup>  | 1 770              | 1 270    | 180     | 129      | 30 000          | 45 000 | K4×7×7T2        | 0.0005    |
| 5                   | 8     | 8 <sup>-0.2<br/>-0.55</sup>  | 2 640              | 2 190    | 269     | 224      | 27 000          | 40 000 | K5×8×8T2        | 0.0007    |
|                     | 8     | 10 <sup>-0.2<br/>-0.55</sup> | 2 720              | 2 250    | 277     | 230      | 27 000          | 40 000 | K5×8×10T2       | 0.0009    |
| 6                   | 9     | 8                            | 2 660              | 2 280    | 272     | 233      | 25 000          | 37 000 | K6×9×8T2        | 0.0009    |
|                     | 9     | 10 <sup>-0.2<br/>-0.55</sup> | 3 400              | 3 150    | 345     | 320      | 25 000          | 37 000 | K6×9×10T2       | 0.0011    |
|                     | 10    | 13                           | 4 400              | 3 700    | 450     | 380      | 25 000          | 37 000 | K6×10×13T2      | 0.0019    |
| 7                   | 10    | 8 <sup>-0.2<br/>-0.55</sup>  | 2 670              | 2 350    | 272     | 239      | 23 000          | 34 000 | K7×10×8T2       | 0.0009    |
|                     | 10    | 10 <sup>-0.2<br/>-0.55</sup> | 3 400              | 3 200    | 345     | 330      | 23 000          | 34 000 | K7×10×10T2      | 0.0011    |
| 8                   | 11    | 8                            | 3 150              | 3 000    | 320     | 305      | 21 000          | 32 000 | K8×11×8T2       | 0.0011    |
|                     | 11    | 10                           | 4 000              | 4 100    | 410     | 420      | 21 000          | 32 000 | K8×11×10T2      | 0.0013    |
|                     | 11    | 13 <sup>-0.2<br/>-0.55</sup> | 4 850              | 5 200    | 495     | 535      | 21 000          | 32 000 | K8×11×13        | 0.0026    |
|                     | 12    | 10 <sup>-0.2<br/>-0.55</sup> | 4 650              | 4 150    | 475     | 425      | 21 000          | 32 000 | K8×12×10T2      | 0.0020    |
|                     | 12    | 12                           | 5 600              | 5 300    | 570     | 540      | 21 000          | 32 000 | K8×12×12        | 0.0034    |
|                     | 12    | 13                           | 5 600              | 5 300    | 570     | 540      | 21 000          | 32 000 | K8×12×13        | 0.0036    |
| 9                   | 12    | 10 <sup>-0.2<br/>-0.55</sup> | 4 550              | 5 000    | 465     | 510      | 20 000          | 30 000 | K9×12×10T2      | 0.0015    |
|                     | 12    | 13 <sup>-0.2<br/>-0.55</sup> | 5 500              | 6 400    | 560     | 650      | 20 000          | 30 000 | K9×12×13T2      | 0.0021    |
| 10                  | 13    | 10                           | 4 550              | 5 100    | 460     | 520      | 19 000          | 28 000 | K10×13×10T2     | 0.0016    |
|                     | 13    | 13                           | 5 450              | 6 450    | 555     | 660      | 19 000          | 28 000 | K10×13×13       | 0.0031    |
|                     | 14    | 8 <sup>-0.2<br/>-0.55</sup>  | 4 300              | 3 950    | 435     | 405      | 19 000          | 28 000 | K10×14×8        | 0.0027    |
|                     | 14    | 10 <sup>-0.2<br/>-0.55</sup> | 5 500              | 5 450    | 560     | 555      | 19 000          | 28 000 | K10×14×10       | 0.0034    |
|                     | 14    | 13                           | 6 600              | 6 900    | 675     | 705      | 19 000          | 28 000 | K10×14×13       | 0.0044    |
|                     | 16    | 12                           | 7 100              | 5 950    | 720     | 610      | 19 000          | 28 000 | K10×16×12       | 0.0066    |
| 11                  | 14    | 10 <sup>-0.2<br/>-0.55</sup> | 5 050              | 6 000    | 515     | 615      | 18 000          | 27 000 | K11×14×10       | 0.0028    |
| 12                  | 15    | 9                            | 4 450              | 5 250    | 455     | 535      | 17 000          | 26 000 | K12×15×9        | 0.0027    |
|                     | 15    | 10                           | 5 000              | 6 100    | 510     | 620      | 17 000          | 26 000 | K12×15×10S      | 0.0033    |
|                     | 15    | 13 <sup>-0.2<br/>-0.55</sup> | 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    |

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.

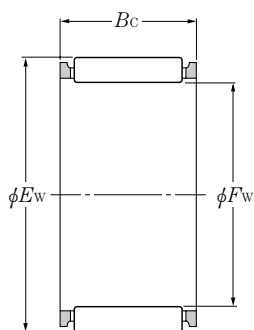


$F_w$  12~16mm

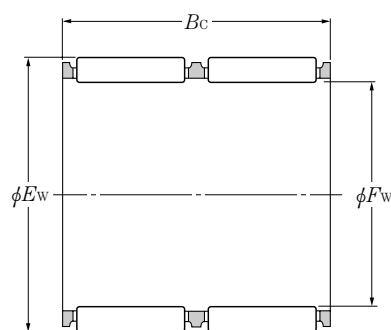
| Boundary dimensions |       |                                     | Basic load ratings |          |         |          | Limiting speeds |        | Bearing numbers | Mass      |
|---------------------|-------|-------------------------------------|--------------------|----------|---------|----------|-----------------|--------|-----------------|-----------|
| mm                  |       |                                     | dynamic            | static   | dynamic | static   | r/min           |        |                 | kg        |
|                     |       |                                     | N                  |          | kgf     |          | grease          | oil    |                 | (approx.) |
| $F_w$               | $E_w$ | $B_c$                               | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ |                 |        |                 |           |
| 12                  | 16    | 13                                  | 7 500              | 8 500    | 765     | 870      | 17 000          | 26 000 | K12×16×13       | 0.0055    |
|                     | 17    | 13 <sup>-0.2</sup> <sub>-0.55</sub> | 9 000              | 9 400    | 920     | 960      | 17 000          | 26 000 | K12×17×13       | 0.0075    |
|                     | 18    | 12                                  | 8 650              | 8 000    | 880     | 815      | 17 000          | 26 000 | K12×18×12       | 0.0084    |
| 14                  | 17    | 10                                  | 5 400              | 7 050    | 550     | 720      | 16 000          | 24 000 | K14×17×10       | 0.0033    |
|                     | 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> <sub>-0.55</sub> | 9 650              | 12 300   | 985     | 1 250    | 16 000          | 24 000 | K14×18×15S      | 0.0076    |
|                     | 18    | 17                                  | 10 900             | 14 400   | 1 120   | 1 470    | 16 000          | 24 000 | K14×18×17       | 0.0081    |
|                     | 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    |
|                     | 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    |
| 15                  | 18    | 14                                  | 7 850              | 11 600   | 800     | 1 190    | 15 000          | 23 000 | K15×18×14       | 0.0060    |
|                     | 19    | 10                                  | 6 850              | 8 050    | 700     | 820      | 15 000          | 23 000 | K15×19×10S      | 0.0051    |
|                     | 19    | 13                                  | 8 250              | 10 200   | 840     | 1 040    | 15 000          | 23 000 | K15×19×13S      | 0.0067    |
|                     | 19    | 17                                  | 10 900             | 14 600   | 1 110   | 1 490    | 15 000          | 23 000 | K15×19×17       | 0.0090    |
|                     | 19    | 24 <sup>-0.2</sup> <sub>-0.55</sub> | 14 100             | 20 400   | 1 440   | 2 080    | 15 000          | 23 000 | K15×19×24ZW     | 0.0130    |
|                     | 20    | 13                                  | 10 100             | 11 500   | 1 030   | 1 170    | 15 000          | 23 000 | K15×20×13       | 0.0088    |
|                     | 21    | 15                                  | 11 900             | 12 500   | 1 210   | 1 280    | 15 000          | 23 000 | K15×21×15       | 0.0130    |
|                     | 21    | 17                                  | 15 100             | 17 200   | 1 540   | 1 750    | 15 000          | 23 000 | KMJ15×21×17     | 0.0140    |
|                     | 21    | 21                                  | 16 500             | 19 100   | 1 680   | 1 950    | 15 000          | 23 000 | K15×21×21       | 0.0170    |
| 16                  | 20    | 10                                  | 7 500              | 9 250    | 765     | 945      | 15 000          | 23 000 | K16×20×10       | 0.0057    |
|                     | 20    | 11                                  | 8 300              | 10 500   | 845     | 1 070    | 15 000          | 23 000 | K16×20×11       | 0.0061    |
|                     | 20    | 13                                  | 9 050              | 11 800   | 925     | 1 200    | 15 000          | 23 000 | K16×20×13       | 0.0071    |
|                     | 20    | 17 <sup>-0.2</sup> <sub>-0.55</sub> | 11 900             | 16 800   | 1 220   | 1 710    | 15 000          | 23 000 | K16×20×17S      | 0.0092    |
|                     | 22    | 12                                  | 11 700             | 12 500   | 1 190   | 1 280    | 15 000          | 23 000 | K16×22×12       | 0.0100    |
|                     | 22    | 13                                  | 12 600             | 13 900   | 1 290   | 1 410    | 15 000          | 23 000 | KMJ16×22×13     | 0.0110    |
|                     | 22    | 16                                  | 14 200             | 16 100   | 1 450   | 1 650    | 15 000          | 23 000 | KMJ16×22×16     | 0.0140    |
|                     | 22    | 17                                  | 14 400             | 16 400   | 1 470   | 1 670    | 15 000          | 23 000 | K16×22×17       | 0.0150    |

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··S  
Type K··ZW  
Type KMJ  
Type KMJ··S



Type K  
Type K··S



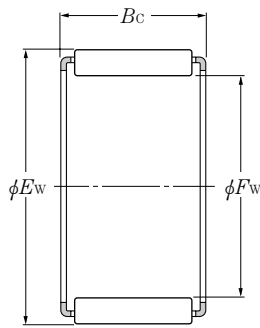
Type K··ZW

$F_w$  16~20mm

| Boundary dimensions |       |                              | Basic load ratings |          |         |          | Limiting speeds |        | Bearing numbers | Mass      |
|---------------------|-------|------------------------------|--------------------|----------|---------|----------|-----------------|--------|-----------------|-----------|
| mm                  |       |                              | dynamic            | static   | dynamic | static   | r/min           |        |                 |           |
| $F_w$               | $E_w$ | $B_c$                        | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ | grease          | oil    |                 | kg        |
|                     |       |                              |                    |          | kgf     |          |                 |        |                 | (approx.) |
| 16                  | 22    | 20 <sup>-0.2<br/>-0.55</sup> | 16 000             | 18 800   | 1 640   | 1 920    | 15 000          | 23 000 | K16×22×20       | 0.0170    |
| 17                  | 21    | 10                           | 7 450              | 9 300    | 760     | 950      | 15 000          | 22 000 | K17×21×10S      | 0.0056    |
|                     | 21    | 13                           | 9 400              | 12 600   | 960     | 1 280    | 15 000          | 22 000 | K17×21×13S      | 0.0075    |
|                     | 21    | 15 <sup>-0.2<br/>-0.55</sup> | 10 400             | 14 400   | 1 060   | 1 460    | 15 000          | 22 000 | K17×21×15       | 0.0089    |
|                     | 21    | 17                           | 11 800             | 16 900   | 1 210   | 1 720    | 15 000          | 22 000 | K17×21×17       | 0.0095    |
|                     | 22    | 20                           | 14 700             | 19 200   | 1 500   | 1 960    | 15 000          | 22 000 | K17×22×20       | 0.0150    |
|                     | 23    | 17                           | 14 400             | 16 500   | 1 460   | 1 690    | 15 000          | 22 000 | K17×23×17       | 0.0160    |
| 18                  | 22    | 10                           | 7 400              | 9 400    | 755     | 955      | 14 000          | 21 000 | K18×22×10       | 0.0061    |
|                     | 22    | 13                           | 8 900              | 11 900   | 910     | 1 210    | 14 000          | 21 000 | K18×22×13       | 0.0077    |
|                     | 22    | 17                           | 11 700             | 17 000   | 1 200   | 1 730    | 14 000          | 21 000 | K18×22×17       | 0.0110    |
|                     | 23    | 20                           | 14 600             | 19 300   | 1 490   | 1 970    | 14 000          | 21 000 | K18×23×20S      | 0.0150    |
|                     | 24    | 12 <sup>-0.2<br/>-0.55</sup> | 12 300             | 13 800   | 1 250   | 1 410    | 14 000          | 21 000 | K18×24×12       | 0.0120    |
|                     | 24    | 13                           | 11 600             | 12 800   | 1 180   | 1 300    | 14 000          | 21 000 | K18×24×13       | 0.0130    |
|                     | 24    | 17                           | 16 000             | 19 300   | 1 630   | 1 970    | 14 000          | 21 000 | KMJ18×24×17S    | 0.0140    |
|                     | 24    | 20                           | 17 000             | 20 900   | 1 730   | 2 130    | 14 000          | 21 000 | K18×24×20       | 0.0190    |
|                     | 25    | 17                           | 18 000             | 20 400   | 1 830   | 2 080    | 14 000          | 21 000 | K18×25×17       | 0.0190    |
|                     | 25    | 22                           | 22 100             | 26 600   | 2 250   | 2 710    | 14 000          | 21 000 | K18×25×22       | 0.0240    |
| 19                  | 23    | 13 <sup>-0.2<br/>-0.55</sup> | 9 650              | 13 500   | 985     | 1 370    | 14 000          | 21 000 | K19×23×13       | 0.0082    |
|                     | 23    | 17                           | 12 700             | 19 200   | 1 300   | 1 960    | 14 000          | 21 000 | K19×23×17       | 0.0110    |
| 20                  | 24    | 10                           | 8 300              | 11 200   | 845     | 1 150    | 13 000          | 20 000 | K20×24×10S      | 0.0065    |
|                     | 24    | 11                           | 9 500              | 13 400   | 970     | 1 370    | 13 000          | 20 000 | K20×24×11       | 0.0072    |
|                     | 24    | 13                           | 10 000             | 14 300   | 1 020   | 1 460    | 13 000          | 20 000 | K20×24×13S      | 0.0086    |
|                     | 24    | 17                           | 13 200             | 20 400   | 1 340   | 2 080    | 13 000          | 20 000 | K20×24×17S      | 0.0110    |
|                     | 24    | 45                           | 16 400             | 27 100   | 1 680   | 2 760    | 13 000          | 20 000 | K20×24×45ZW     | 0.0280    |
|                     | 25    | 40 <sup>-0.2<br/>-0.55</sup> | 29 000             | 48 000   | 2 950   | 4 900    | 13 000          | 20 000 | K20×25×40ZW     | 0.0330    |
|                     | 26    | 12                           | 12 900             | 15 100   | 1 320   | 1 540    | 13 000          | 20 000 | K20×26×12       | 0.0130    |
|                     | 26    | 13                           | 14 000             | 16 700   | 1 420   | 1 700    | 13 000          | 20 000 | KMJ20×26×13     | 0.0120    |
|                     | 26    | 17                           | 17 800             | 22 800   | 1 810   | 2 330    | 13 000          | 20 000 | KMJ20×26×17S    | 0.0160    |
|                     | 26    | 20                           | 20 600             | 27 600   | 2 100   | 2 820    | 13 000          | 20 000 | KMJ20×26×20S    | 0.0190    |
|                     | 28    | 25                           | 27 100             | 32 500   | 2 760   | 3 300    | 13 000          | 20 000 | K20×28×25       | 0.0370    |

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.





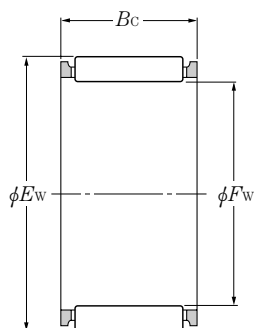
Type KMJ  
Type KMJ · · S

$F_w$  21~25mm

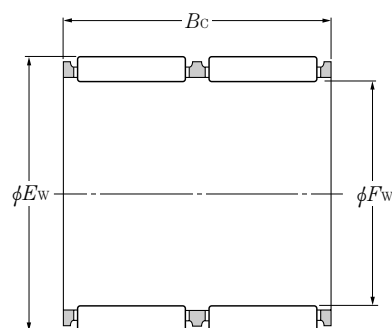
| Boundary dimensions |       |                                     | Basic load ratings |          |         |          | Limiting speeds |        | Bearing numbers | Mass      |
|---------------------|-------|-------------------------------------|--------------------|----------|---------|----------|-----------------|--------|-----------------|-----------|
|                     |       |                                     | dynamic            | static   | dynamic | static   |                 |        |                 | kg        |
| mm                  |       |                                     | N                  |          | kgf     |          | r/min           |        |                 |           |
| $F_w$               | $E_w$ | $B_c$                               | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ | grease          | oil    |                 | (approx.) |
| 21                  | 25    | 13 <sub>-0.2</sub> <sup>-0.55</sup> | 10 300             | 15 100   | 1 050   | 1 540    | 13 000          | 19 000 | K21×25×13       | 0.0090    |
|                     | 25    | 17 <sub>-0.2</sub> <sup>-0.55</sup> | 13 600             | 21 500   | 1 380   | 2 200    | 13 000          | 19 000 | K21×25×17       | 0.0120    |
| 22                  | 26    | 10                                  | 8 500              | 11 900   | 865     | 1 220    | 12 000          | 18 000 | K22×26×10S      | 0.0071    |
|                     | 26    | 11                                  | 10 100             | 14 900   | 1 030   | 1 520    | 12 000          | 18 000 | K22×26×11S      | 0.0079    |
|                     | 26    | 13                                  | 10 200             | 15 200   | 1 040   | 1 550    | 12 000          | 18 000 | K22×26×13       | 0.0094    |
|                     | 26    | 17 <sub>-0.2</sub> <sup>-0.55</sup> | 13 500             | 21 600   | 1 370   | 2 200    | 12 000          | 18 000 | K22×26×17S      | 0.0120    |
|                     | 27    | 20 <sub>-0.2</sub> <sup>-0.55</sup> | 17 500             | 25 900   | 1 780   | 2 640    | 12 000          | 18 000 | K22×27×20       | 0.0200    |
|                     | 27    | 40                                  | 29 900             | 51 500   | 3 050   | 5 250    | 12 000          | 18 000 | K22×27×40ZW     | 0.0390    |
|                     | 28    | 17                                  | 17 700             | 23 300   | 1 810   | 2 380    | 12 000          | 18 000 | K22×28×17       | 0.0200    |
|                     | 29    | 16                                  | 18 700             | 22 700   | 1 910   | 2 310    | 12 000          | 18 000 | KMJ22×29×16     | 0.0220    |
|                     | 30    | 15                                  | 19 300             | 21 700   | 1 970   | 2 210    | 12 000          | 18 000 | K22×30×15       | 0.0220    |
| 23                  | 28    | 24 <sub>-0.2</sub> <sup>-0.55</sup> | 19 800             | 31 000   | 2 020   | 3 150    | 11 000          | 17 000 | K23×28×24       | 0.0230    |
| 24                  | 28    | 10                                  | 9 000              | 13 200   | 915     | 1 350    | 11 000          | 17 000 | K24×28×10S      | 0.0081    |
|                     | 28    | 13                                  | 10 800             | 16 800   | 1 100   | 1 710    | 11 000          | 17 000 | K24×28×13       | 0.0100    |
|                     | 28    | 17 <sub>-0.2</sub> <sup>-0.55</sup> | 14 300             | 23 900   | 1 460   | 2 440    | 11 000          | 17 000 | K24×28×17       | 0.0130    |
|                     | 29    | 13 <sub>-0.2</sub> <sup>-0.55</sup> | 12 300             | 16 900   | 1 250   | 1 720    | 11 000          | 17 000 | K24×29×13       | 0.0120    |
|                     | 30    | 17                                  | 18 400             | 25 200   | 1 880   | 2 570    | 11 000          | 17 000 | K24×30×17       | 0.0220    |
|                     | 30    | 31                                  | 27 900             | 43 000   | 2 840   | 4 350    | 11 000          | 17 000 | K24×30×31ZW     | 0.0390    |
| 25                  | 29    | 10                                  | 8 950              | 13 300   | 910     | 1 350    | 11 000          | 16 000 | K25×29×10       | 0.0083    |
|                     | 29    | 13                                  | 10 800             | 16 900   | 1 100   | 1 720    | 11 000          | 16 000 | K25×29×13       | 0.0100    |
|                     | 29    | 17                                  | 14 200             | 24 000   | 1 450   | 2 450    | 11 000          | 16 000 | K25×29×17S      | 0.0140    |
|                     | 30    | 13                                  | 13 200             | 18 800   | 1 350   | 1 920    | 11 000          | 16 000 | K25×30×13       | 0.0130    |
|                     | 30    | 17                                  | 17 400             | 26 800   | 1 770   | 2 730    | 11 000          | 16 000 | K25×30×17S      | 0.0170    |
|                     | 30    | 20 <sub>-0.2</sub> <sup>-0.55</sup> | 19 400             | 31 000   | 1 980   | 3 150    | 11 000          | 16 000 | K25×30×20S      | 0.0210    |
|                     | 30    | 26 <sub>-0.2</sub> <sup>-0.55</sup> | 21 800             | 35 500   | 2 220   | 3 650    | 11 000          | 16 000 | K25×30×26ZW     | 0.0270    |
|                     | 30    | 39                                  | 29 800             | 53 500   | 3 050   | 5 450    | 11 000          | 16 000 | K25×30×39ZW     | 0.0400    |
|                     | 31    | 13                                  | 15 200             | 19 900   | 1 550   | 2 030    | 11 000          | 16 000 | K25×31×13       | 0.0160    |
|                     | 31    | 14                                  | 16 500             | 22 100   | 1 680   | 2 250    | 11 000          | 16 000 | K25×31×14       | 0.0180    |
|                     | 31    | 17                                  | 18 300             | 25 300   | 1 870   | 2 580    | 11 000          | 16 000 | K25×31×17       | 0.0220    |
|                     | 31    | 21                                  | 22 500             | 33 000   | 2 290   | 3 350    | 11 000          | 16 000 | K25×31×21       | 0.0260    |

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··S  
Type K··ZW  
Type KMJ  
Type KMJ··S  
Type KJ··S



Type K  
Type K··S

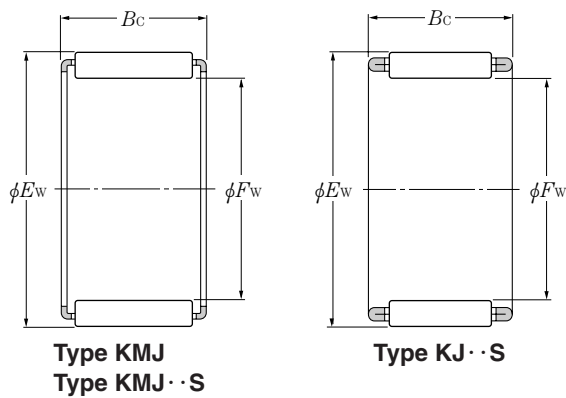


Type K··ZW

$F_w$  25~32mm

| Boundary dimensions |       |                              | Basic load ratings |          |         |          | Limiting speeds |        | Bearing numbers | Mass      |
|---------------------|-------|------------------------------|--------------------|----------|---------|----------|-----------------|--------|-----------------|-----------|
| mm                  |       |                              | dynamic            | static   | dynamic | static   | r/min           |        |                 | kg        |
|                     |       |                              | N                  |          | kgf     |          | grease          | oil    |                 | (approx.) |
| $F_w$               | $E_w$ | $B_c$                        | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ |                 |        |                 |           |
| 25                  | 32    | 16 <sub>-0.2<br/>-0.55</sub> | 19 500             | 24 700   | 1 990   | 2 520    | 11 000          | 16 000 | KMJ25×32×16     | 0.025     |
|                     | 33    | 24                           | 34 500             | 47 000   | 3 500   | 4 800    | 11 000          | 16 000 | KMJ25×33×24S    | 0.040     |
| 26                  | 30    | 13                           | 11 800             | 19 200   | 1 200   | 1 960    | 10 000          | 15 000 | K26×30×13       | 0.011     |
|                     | 30    | 17 <sub>-0.2<br/>-0.55</sub> | 15 500             | 27 400   | 1 580   | 2 790    | 10 000          | 15 000 | K26×30×17       | 0.015     |
|                     | 34    | 22                           | 24 200             | 30 000   | 2 470   | 3 050    | 10 000          | 15 000 | K26×34×22       | 0.041     |
| 28                  | 32    | 17                           | 15 300             | 27 500   | 1 560   | 2 810    | 9 500           | 14 000 | K28×32×17       | 0.017     |
|                     | 32    | 21                           | 18 700             | 35 500   | 1 910   | 3 650    | 9 500           | 14 000 | K28×32×21       | 0.020     |
|                     | 33    | 13                           | 13 900             | 20 900   | 1 420   | 2 130    | 9 500           | 14 000 | K28×33×13       | 0.015     |
|                     | 33    | 17                           | 18 300             | 29 800   | 1 870   | 3 050    | 9 500           | 14 000 | K28×33×17S      | 0.020     |
|                     | 33    | 26 <sub>-0.2<br/>-0.55</sub> | 23 900             | 42 000   | 2 430   | 4 250    | 9 500           | 14 000 | K28×33×26ZW     | 0.033     |
|                     | 33    | 27                           | 28 300             | 52 000   | 2 890   | 5 300    | 9 500           | 14 000 | K28×33×27       | 0.032     |
|                     | 34    | 14                           | 17 500             | 24 800   | 1 790   | 2 530    | 9 500           | 14 000 | K28×34×14       | 0.020     |
|                     | 34    | 17                           | 18 100             | 25 800   | 1 850   | 2 630    | 9 500           | 14 000 | K28×34×17       | 0.024     |
|                     | 35    | 16                           | 21 200             | 28 400   | 2 160   | 2 900    | 9 500           | 14 000 | K28×35×16       | 0.029     |
|                     | 35    | 18                           | 21 500             | 28 900   | 2 190   | 2 950    | 9 500           | 14 000 | K28×35×18       | 0.031     |
| 29                  | 34    | 17 <sub>-0.2<br/>-0.55</sub> | 18 900             | 31 000   | 1 920   | 3 200    | 9 500           | 14 000 | K29×34×17S      | 0.022     |
|                     | 34    | 27                           | 28 100             | 52 000   | 2 870   | 5 300    | 9 500           | 14 000 | K29×34×27       | 0.033     |
| 30                  | 35    | 11                           | 12 200             | 18 000   | 1 240   | 1 840    | 8 500           | 13 000 | K30×35×11S      | 0.014     |
|                     | 35    | 13                           | 14 700             | 22 900   | 1 500   | 2 340    | 8 500           | 13 000 | K30×35×13S      | 0.016     |
|                     | 35    | 17                           | 19 400             | 32 500   | 1 970   | 3 350    | 8 500           | 13 000 | KJ30×35×17S     | 0.021     |
|                     | 35    | 20                           | 21 600             | 37 500   | 2 200   | 3 850    | 8 500           | 13 000 | K30×35×20S      | 0.025     |
|                     | 35    | 26                           | 25 200             | 46 000   | 2 570   | 4 650    | 8 500           | 13 000 | K30×35×26ZW     | 0.032     |
|                     | 35    | 27 <sub>-0.2<br/>-0.55</sub> | 29 900             | 57 000   | 3 050   | 5 800    | 8 500           | 13 000 | K30×35×27S      | 0.033     |
|                     | 36    | 14                           | 18 600             | 27 400   | 1 900   | 2 790    | 8 500           | 13 000 | KMJ30×36×14     | 0.022     |
|                     | 37    | 16                           | 21 900             | 30 500   | 2 230   | 3 100    | 8 500           | 13 000 | K30×37×16       | 0.029     |
|                     | 37    | 18                           | 23 300             | 33 000   | 2 370   | 3 350    | 8 500           | 13 000 | K30×37×18       | 0.034     |
|                     | 37    | 20                           | 26 200             | 38 000   | 2 670   | 3 850    | 8 500           | 13 000 | KMJ30×37×20     | 0.038     |
|                     | 37    | 48                           | 40 000             | 65 500   | 4 050   | 6 700    | 8 500           | 13 000 | K30×37×48ZW     | 0.075     |
|                     | 38    | 18                           | 25 000             | 33 000   | 2 550   | 3 350    | 8 500           | 13 000 | K30×38×18       | 0.036     |
| 32                  | 36    | 15 <sub>-0.2<br/>-0.55</sub> | 14 300             | 26 400   | 1 460   | 2 700    | 8 500           | 13 000 | K32×36×15S      | 0.017     |

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.

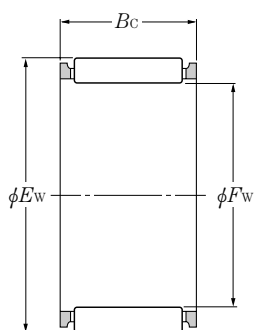


$F_w$  32~38mm

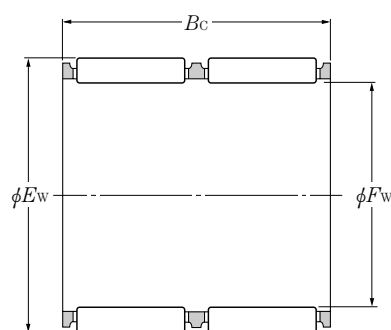
| Boundary dimensions |       |                                        | Basic load ratings |          |         |          | Limiting speeds |        | Bearing numbers | Mass      |
|---------------------|-------|----------------------------------------|--------------------|----------|---------|----------|-----------------|--------|-----------------|-----------|
| mm                  |       |                                        | dynamic            | static   | dynamic | static   | r/min           |        |                 | kg        |
|                     |       |                                        | N                  |          | kgf     |          | grease          | oil    |                 | (approx.) |
| $F_w$               | $E_w$ | $B_c$                                  | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ |                 |        |                 |           |
| 32                  | 37    | 13                                     | 14 500             | 23 000   | 1 480   | 2 350    | 8 500           | 13 000 | K32×37×13       | 0.018     |
|                     | 37    | 17                                     | 19 200             | 33 000   | 1 950   | 3 350    | 8 500           | 13 000 | K32×37×17S      | 0.022     |
|                     | 37    | 26                                     | 24 900             | 46 000   | 2 540   | 4 700    | 8 500           | 13 000 | K32×37×26ZW     | 0.034     |
|                     | 37    | 27                                     | 29 600             | 57 500   | 3 000   | 5 850    | 8 500           | 13 000 | KJ32×37×27S     | 0.037     |
|                     | 38    | 14 <sup>-0.2</sup>                     | 19 800             | 30 500   | 2 020   | 3 100    | 8 500           | 13 000 | KMJ32×38×14     | 0.022     |
|                     | 38    | 20 <sup>-0.55</sup>                    | 25 100             | 41 000   | 2 560   | 4 150    | 8 500           | 13 000 | KJ32×38×20S     | 0.031     |
|                     | 38    | 26                                     | 31 500             | 54 000   | 3 200   | 5 550    | 8 500           | 13 000 | K32×38×26       | 0.041     |
|                     | 39    | 16                                     | 22 600             | 32 000   | 2 310   | 3 300    | 8 500           | 13 000 | K32×39×16       | 0.034     |
|                     | 39    | 18                                     | 24 000             | 35 000   | 2 450   | 3 550    | 8 500           | 13 000 | K32×39×18       | 0.037     |
|                     | 39    | 20                                     | 26 800             | 40 000   | 2 740   | 4 100    | 8 500           | 13 000 | KJ32×39×20S     | 0.041     |
| 35                  | 40    | 13                                     | 15 200             | 25 100   | 1 550   | 2 560    | 7 500           | 11 000 | K35×40×13       | 0.019     |
|                     | 40    | 17                                     | 20 000             | 36 000   | 2 040   | 3 650    | 7 500           | 11 000 | K35×40×17       | 0.025     |
|                     | 40    | 26                                     | 26 100             | 50 000   | 2 660   | 5 100    | 7 500           | 11 000 | K35×40×26ZW     | 0.037     |
|                     | 40    | 27                                     | 32 000             | 65 000   | 3 250   | 6 600    | 7 500           | 11 000 | KJ35×40×27S     | 0.039     |
|                     | 40    | 30                                     | 26 100             | 50 000   | 2 660   | 5 100    | 7 500           | 11 000 | K35×40×30ZW     | 0.043     |
|                     | 41    | 14                                     | 19 400             | 30 500   | 1 980   | 3 100    | 7 500           | 11 000 | K35×41×14       | 0.026     |
|                     | 41    | 15 <sup>-0.2</sup>                     | 20 900             | 33 500   | 2 130   | 3 400    | 7 500           | 11 000 | K35×41×15       | 0.027     |
|                     | 41    | 40 <sup>-0.55</sup>                    | 43 000             | 84 000   | 4 400   | 8 550    | 7 500           | 11 000 | K35×41×40ZW     | 0.055     |
|                     | 42    | 16                                     | 24 100             | 36 000   | 2 450   | 3 650    | 7 500           | 11 000 | K35×42×16       | 0.035     |
|                     | 42    | 18                                     | 24 700             | 37 000   | 2 510   | 3 750    | 7 500           | 11 000 | K35×42×18       | 0.039     |
|                     | 42    | 20                                     | 28 500             | 44 500   | 2 910   | 4 550    | 7 500           | 11 000 | K35×42×20       | 0.041     |
|                     | 42    | 30                                     | 39 500             | 68 000   | 4 050   | 6 950    | 7 500           | 11 000 | K35×42×30       | 0.062     |
|                     | 42    | 45                                     | 42 500             | 74 000   | 4 300   | 7 550    | 7 500           | 11 000 | K35×42×45ZW     | 0.106     |
| 36                  | 42    | 46 <sup>-0.2</sup><br><sub>-0.55</sub> | 51 000             | 106 000  | 5 200   | 10 800   | 7 500           | 11 000 | K36×42×46ZW     | 0.086     |
| 37                  | 42    | 13                                     | 15 900             | 27 100   | 1 620   | 2 770    | 7 500           | 11 000 | K37×42×13       | 0.021     |
|                     | 42    | 17 <sup>-0.2</sup><br><sub>-0.55</sub> | 20 400             | 37 500   | 2 080   | 3 800    | 7 500           | 11 000 | KJ37×42×17S     | 0.026     |
|                     | 42    | 27                                     | 32 500             | 67 500   | 3 300   | 6 900    | 7 500           | 11 000 | KJ37×42×27S     | 0.041     |
|                     | 44    | 18                                     | 26 300             | 41 000   | 2 680   | 4 150    | 7 500           | 11 000 | K37×44×18       | 0.042     |
| 38                  | 43    | 17 <sup>-0.2</sup><br><sub>-0.55</sub> | 20 900             | 38 500   | 2 130   | 3 950    | 7 500           | 11 000 | K38×43×17       | 0.026     |
|                     | 43    | 27                                     | 32 000             | 67 500   | 3 300   | 6 900    | 7 500           | 11 000 | K38×43×27       | 0.043     |

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··ZW  
Type KMJ  
Type KJ··S



Type K

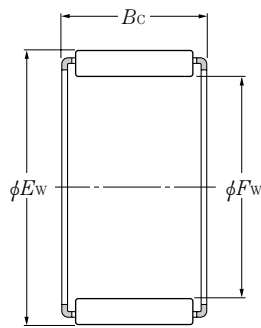


Type K··ZW

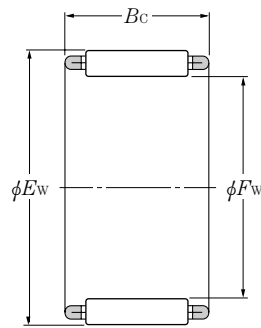
$F_w$  38~48mm

| Boundary dimensions |       |                      | Basic load ratings |          |         |          | Limiting speeds |             | Bearing numbers | Mass      |
|---------------------|-------|----------------------|--------------------|----------|---------|----------|-----------------|-------------|-----------------|-----------|
| mm                  |       |                      | dynamic            | static   | dynamic | static   | r/min           |             |                 | kg        |
| $F_w$               | $E_w$ | $B_c$                | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ | grease          | oil         |                 | (approx.) |
| 38                  | 46    | 20 <sup>−0.2</sup>   | 34 000             | 52 000   | 3 450   | 5 350    | 7 500           | 11 000      | KMJ38×46×20     | 0.046     |
|                     | 46    | 32 <sup>−0.55</sup>  | 54 000             | 95 500   | 5 500   | 9 700    | 7 500           | 11 000      | K38×46×32       | 0.073     |
| 40                  | 45    | 13                   | 16 500             | 29 200   | 1 680   | 2 980    | 6 500           | 10 000      | K40×45×13       | 0.022     |
|                     | 45    | 17                   | 21 800             | 41 500   | 2 220   | 4 250    | 6 500           | 10 000      | K40×45×17       | 0.027     |
|                     | 45    | 21                   | 26 700             | 54 000   | 2 720   | 5 500    | 6 500           | 10 000      | K40×45×21       | 0.037     |
|                     | 45    | 27                   | 33 500             | 72 500   | 3 400   | 7 400    | 6 500           | 10 000      | K40×45×27       | 0.044     |
|                     | 46    | 17 <sup>−0.2</sup>   | 24 600             | 43 000   | 2 500   | 4 350    | 6 500           | 10 000      | K40×46×17       | 0.030     |
|                     | 47    | 18 <sup>−0.55</sup>  | 27 700             | 45 000   | 2 820   | 4 550    | 6 500           | 10 000      | K40×47×18       | 0.045     |
|                     | 47    | 20                   | 31 000             | 51 500   | 3 150   | 5 250    | 6 500           | 10 000      | K40×47×20       | 0.048     |
|                     | 48    | 20                   | 33 000             | 51 000   | 3 350   | 5 200    | 6 500           | 10 000      | K40×48×20       | 0.052     |
|                     | 48    | 25                   | 42 500             | 71 000   | 4 350   | 7 250    | 6 500           | 10 000      | K40×48×25       | 0.065     |
| 42                  | 47    | 17                   | 22 100             | 43 000   | 2 250   | 4 400    | 6 500           | 9 500       | K42×47×17       | 0.028     |
|                     | 47    | 27 <sup>−0.2</sup>   | 34 000             | 75 500   | 3 450   | 7 700    | 6 500           | 9 500       | K42×47×27       | 0.047     |
|                     | 48    | 17 <sup>−0.55</sup>  | 25 700             | 46 000   | 2 630   | 4 700    | 6 500           | 9 500       | K42×48×17       | 0.036     |
|                     | 50    | 20                   | 34 000             | 53 500   | 3 450   | 5 500    | 6 500           | 9 500       | K42×50×20       | 0.054     |
| 43                  | 48    | 17                   | 22 000             | 43 000   | 2 240   | 4 400    | 6 500           | 9 500       | K43×48×17       | 0.029     |
|                     | 48    | 27 <sup>−0.2</sup>   | 34 000             | 75 500   | 3 450   | 7 700    | 6 500           | 9 500       | K43×48×27       | 0.046     |
|                     | 50    | 18 <sup>−0.55</sup>  | 29 100             | 49 000   | 2 960   | 5 000    | 6 500           | 9 500       | K43×50×18       | 0.049     |
| 45                  | 49    | 19                   | 22 100             | 52 000   | 2 260   | 5 300    | 6 000           | 9 000       | K45×49×19       | 0.027     |
|                     | 50    | 17                   | 22 800             | 46 000   | 2 330   | 4 700    | 6 000           | 9 000       | KJ45×50×17S     | 0.031     |
|                     | 50    | 27                   | 34 500             | 78 000   | 3 500   | 7 950    | 6 000           | 9 000       | K45×50×27       | 0.050     |
|                     | 52    | 18 <sup>−0.2</sup>   | 29 700             | 51 000   | 3 000   | 5 200    | 6 000           | 9 000       | K45×52×18       | 0.051     |
|                     | 52    | 21 <sup>−0.55</sup>  | 32 000             | 56 500   | 3 300   | 5 750    | 6 000           | 9 000       | K45×52×21       | 0.061     |
|                     | 53    | 20                   | 36 000             | 59 000   | 3 650   | 6 000    | 6 000           | 9 000       | K45×53×20       | 0.062     |
|                     | 53    | 25                   | 46 500             | 82 000   | 4 700   | 8 400    | 6 000           | 9 000       | K45×53×25       | 0.077     |
| 53                  | 28    | 49 500               | 90 000             | 5 050    | 9 200   | 6 000    | 9 000           | KJ45×53×28S | 0.078           |           |
| 47                  | 52    | 17 <sup>−0.2</sup>   | 23 200             | 47 500   | 2 360   | 4 850    | 5 500           | 8 500       | K47×52×17       | 0.033     |
|                     | 52    | 27 <sup>−0.55</sup>  | 35 500             | 83 000   | 3 650   | 8 450    | 5 500           | 8 500       | K47×52×27       | 0.051     |
| 48                  | 53    | 37.5 <sup>−0.2</sup> | 41 500             | 101 000  | 4 200   | 10 300   | 5 500           | 8 500       | K48×53×37.5ZW   | 0.072     |

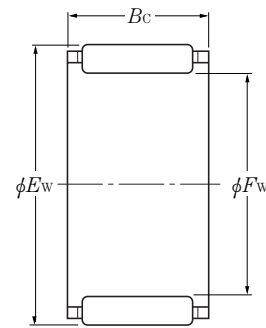
Remarks: Even when an order is placed with reference to "Nominal bearing number" listed in this table, the ordered bearings are subject to being delivered with different cage type.



Type KMJ



Type KJ·S



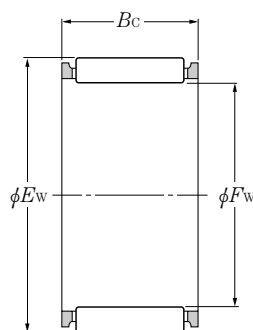
Type KV·S

$F_w$  48~60mm

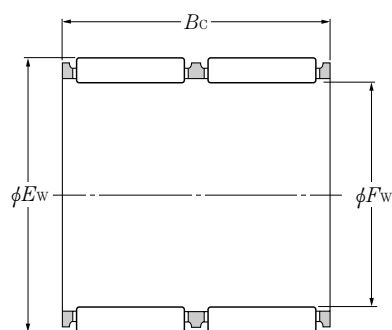
| Boundary dimensions |       |                                                          | Basic load ratings |          |         |          | Limiting speeds |       | Bearing numbers | Mass      |
|---------------------|-------|----------------------------------------------------------|--------------------|----------|---------|----------|-----------------|-------|-----------------|-----------|
| mm                  |       |                                                          | dynamic            | static   | dynamic | static   | r/min           |       |                 | kg        |
|                     |       |                                                          | N                  |          | kgf     |          | grease          | oil   |                 | (approx.) |
| $F_w$               | $E_w$ | $B_c$                                                    | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ |                 |       |                 |           |
| 48                  | 54    | 19 $\begin{smallmatrix} -0.2 \\ -0.55 \end{smallmatrix}$ | 31 000             | 61 000   | 3 150   | 6 250    | 5 500           | 8 500 | K48×54×19       | 0.044     |
| 50                  | 55    | 13.5                                                     | 18 100             | 35 500   | 1 850   | 3 600    | 5 500           | 8 000 | K50×55×13.5     | 0.023     |
|                     | 55    | 20                                                       | 27 900             | 62 000   | 2 850   | 6 300    | 5 500           | 8 000 | K50×55×20       | 0.042     |
|                     | 55    | 27                                                       | 37 000             | 88 500   | 3 750   | 9 000    | 5 500           | 8 000 | K50×55×27       | 0.053     |
|                     | 55    | 30 $\begin{smallmatrix} -0.2 \\ -0.55 \end{smallmatrix}$ | 39 500             | 97 000   | 4 050   | 9 900    | 5 500           | 8 000 | K50×55×30       | 0.059     |
|                     | 57    | 18                                                       | 31 500             | 57 000   | 3 200   | 5 800    | 5 500           | 8 000 | K50×57×18       | 0.053     |
|                     | 58    | 20                                                       | 38 500             | 67 500   | 3 950   | 6 850    | 5 500           | 8 000 | K50×58×20       | 0.065     |
|                     | 58    | 25                                                       | 48 500             | 90 000   | 4 950   | 9 150    | 5 500           | 8 000 | K50×58×25       | 0.081     |
| 52                  | 58    | 19 $\begin{smallmatrix} -0.2 \\ -0.55 \end{smallmatrix}$ | 32 000             | 65 500   | 3 250   | 6 650    | 5 000           | 7 500 | K52×58×19       | 0.048     |
| 55                  | 60    | 17                                                       | 25 800             | 58 000   | 2 630   | 5 900    | 5 000           | 7 500 | K55×60×17       | 0.043     |
|                     | 60    | 20                                                       | 28 800             | 66 500   | 2 940   | 6 750    | 5 000           | 7 500 | K55×60×20       | 0.045     |
|                     | 60    | 30                                                       | 42 000             | 108 000  | 4 300   | 11 000   | 5 000           | 7 500 | KV55×60×30S     | 0.069     |
|                     | 61    | 19                                                       | 33 000             | 69 500   | 3 350   | 7 100    | 5 000           | 7 500 | K55×61×19       | 0.051     |
|                     | 61    | 20 $\begin{smallmatrix} -0.2 \\ -0.55 \end{smallmatrix}$ | 33 000             | 69 500   | 3 350   | 7 100    | 5 000           | 7 500 | K55×61×20       | 0.054     |
|                     | 61    | 30 $\begin{smallmatrix} -0.2 \\ -0.55 \end{smallmatrix}$ | 48 000             | 113 000  | 4 900   | 11 500   | 5 000           | 7 500 | K55×61×30       | 0.081     |
|                     | 62    | 18                                                       | 33 500             | 63 000   | 3 400   | 6 450    | 5 000           | 7 500 | K55×62×18       | 0.054     |
|                     | 63    | 20                                                       | 39 000             | 70 000   | 3 950   | 7 100    | 5 000           | 7 500 | K55×63×20       | 0.073     |
|                     | 63    | 25                                                       | 50 500             | 97 500   | 5 150   | 9 950    | 5 000           | 7 500 | K55×63×25       | 0.088     |
|                     | 63    | 32                                                       | 61 000             | 125 000  | 6 200   | 12 700   | 5 000           | 7 500 | K55×63×32       | 0.117     |
| 58                  | 64    | 19 $\begin{smallmatrix} -0.2 \\ -0.55 \end{smallmatrix}$ | 34 000             | 73 500   | 3 450   | 7 500    | 4 700           | 7 000 | K58×64×19       | 0.052     |
| 60                  | 65    | 20                                                       | 29 800             | 71 500   | 3 050   | 7 300    | 4 300           | 6 500 | K60×65×20       | 0.051     |
|                     | 65    | 30                                                       | 43 500             | 116 000  | 4 450   | 11 800   | 4 300           | 6 500 | K60×65×30       | 0.071     |
|                     | 66    | 19                                                       | 33 500             | 73 500   | 3 450   | 7 500    | 4 300           | 6 500 | K60×66×19       | 0.053     |
|                     | 66    | 20                                                       | 33 500             | 73 500   | 3 450   | 7 500    | 4 300           | 6 500 | K60×66×20       | 0.056     |
|                     | 66    | 30 $\begin{smallmatrix} -0.2 \\ -0.55 \end{smallmatrix}$ | 49 000             | 119 000  | 5 000   | 12 200   | 4 300           | 6 500 | K60×66×30       | 0.084     |
|                     | 68    | 15 $\begin{smallmatrix} -0.2 \\ -0.55 \end{smallmatrix}$ | 27 200             | 45 500   | 2 780   | 4 650    | 4 300           | 6 500 | K60×68×15       | 0.058     |
|                     | 68    | 20                                                       | 40 000             | 75 000   | 4 100   | 7 650    | 4 300           | 6 500 | K60×68×20       | 0.077     |
|                     | 68    | 23                                                       | 44 500             | 85 000   | 4 500   | 8 700    | 4 300           | 6 500 | K60×68×23       | 0.092     |
|                     | 68    | 25                                                       | 52 000             | 105 000  | 5 300   | 10 700   | 4 300           | 6 500 | K60×68×25       | 0.097     |
|                     | 68    | 27                                                       | 52 000             | 105 000  | 5 300   | 10 700   | 4 300           | 6 500 | K60×68×27       | 0.098     |

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··ZW  
Type KMJ



Type K



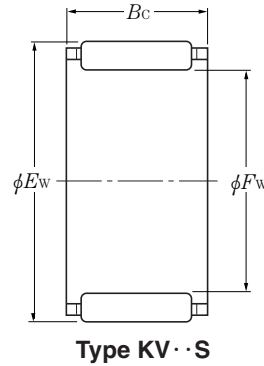
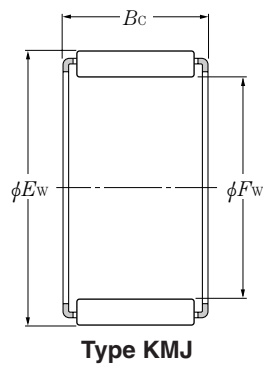
Type K··ZW

$F_w$  60~80mm

| Boundary dimensions |       |                                            | Basic load ratings |          |         |          | Limiting speeds |       | Bearing numbers | Mass      |
|---------------------|-------|--------------------------------------------|--------------------|----------|---------|----------|-----------------|-------|-----------------|-----------|
| mm                  |       |                                            | dynamic            | static   | dynamic | static   | r/min           |       |                 | kg        |
| $F_w$               | $E_w$ | $B_c$                                      | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ | grease          | oil   |                 | (approx.) |
| 60                  | 68    | 30 <sup><math>_{-0.55}^{-0.2}</math></sup> | 46 500             | 91 000   | 4 750   | 9 300    | 4 300           | 6 500 | K60×68×30ZW     | 0.119     |
| 61                  | 66    | 20 <sup><math>_{-0.55}^{-0.2}</math></sup> | 29 700             | 71 500   | 3 050   | 7 300    | 4 300           | 6 500 | K61×66×20       | 0.054     |
|                     | 66    | 30 <sup><math>_{-0.55}^{-0.2}</math></sup> | 43 500             | 116 000  | 4 400   | 11 900   | 4 300           | 6 500 | K61×66×30       | 0.073     |
| 63                  | 70    | 21 <sup><math>_{-0.55}^{-0.2}</math></sup> | 44 500             | 95 500   | 4 500   | 9 700    | 4 300           | 6 500 | K63×70×21       | 0.075     |
| 64                  | 70    | 16 <sup><math>_{-0.55}^{-0.2}</math></sup> | 28 400             | 60 500   | 2 900   | 6 150    | 4 300           | 6 500 | K64×70×16       | 0.053     |
| 65                  | 70    | 20                                         | 30 500             | 75 000   | 3 100   | 7 650    | 4 000           | 6 000 | K65×70×20       | 0.055     |
|                     | 70    | 30 <sup><math>_{-0.55}^{-0.2}</math></sup> | 45 000             | 124 000  | 4 600   | 12 700   | 4 000           | 6 000 | K65×70×30       | 0.083     |
|                     | 73    | 23 <sup><math>_{-0.55}^{-0.2}</math></sup> | 47 000             | 94 000   | 4 800   | 9 600    | 4 000           | 6 000 | K65×73×23       | 0.100     |
|                     | 73    | 30                                         | 61 000             | 132 000  | 6 200   | 13 400   | 4 000           | 6 000 | K65×73×30       | 0.126     |
| 68                  | 74    | 20                                         | 36 000             | 83 500   | 3 700   | 8 550    | 4 000           | 6 000 | K68×74×20       | 0.065     |
|                     | 74    | 30 <sup><math>_{-0.55}^{-0.2}</math></sup> | 51 500             | 133 000  | 5 250   | 13 500   | 4 000           | 6 000 | K68×74×30       | 0.097     |
|                     | 74    | 35 <sup><math>_{-0.55}^{-0.2}</math></sup> | 49 500             | 125 000  | 5 050   | 12 800   | 4 000           | 6 000 | K68×74×35ZW     | 0.116     |
|                     | 75    | 21                                         | 45 500             | 101 000  | 4 600   | 10 300   | 4 000           | 6 000 | K68×75×21       | 0.077     |
| 70                  | 76    | 20                                         | 36 500             | 86 000   | 3 700   | 8 750    | 3 700           | 5 500 | K70×76×20       | 0.070     |
|                     | 76    | 30                                         | 53 000             | 139 000  | 5 400   | 14 200   | 3 700           | 5 500 | K70×76×30       | 0.100     |
|                     | 77    | 21 <sup><math>_{-0.55}^{-0.2}</math></sup> | 45 000             | 101 000  | 4 600   | 10 300   | 3 700           | 5 500 | K70×77×21       | 0.080     |
|                     | 78    | 23                                         | 49 500             | 103 000  | 5 050   | 10 500   | 3 700           | 5 500 | K70×78×23       | 0.107     |
|                     | 78    | 30                                         | 65 500             | 149 000  | 6 700   | 15 200   | 3 700           | 5 500 | K70×78×30       | 0.136     |
| 72                  | 79    | 21 <sup><math>_{-0.55}^{-0.2}</math></sup> | 46 500             | 106 000  | 4 750   | 10 800   | 3 700           | 5 500 | K72×79×21       | 0.085     |
| 73                  | 79    | 20 <sup><math>_{-0.55}^{-0.2}</math></sup> | 39 500             | 95 500   | 4 000   | 9 750    | 3 700           | 5 500 | KMJ73×79×20     | 0.063     |
|                     | 79    | 30 <sup><math>_{-0.55}^{-0.2}</math></sup> | 54 500             | 146 000  | 5 550   | 14 900   | 3 700           | 5 500 | K73×79×30       | 0.106     |
| 75                  | 81    | 20                                         | 40 500             | 100 000  | 4 100   | 10 200   | 3 700           | 5 500 | KMJ75×81×20     | 0.064     |
|                     | 81    | 30                                         | 56 000             | 152 000  | 5 700   | 15 500   | 3 700           | 5 500 | K75×81×30       | 0.108     |
|                     | 82    | 21 <sup><math>_{-0.55}^{-0.2}</math></sup> | 46 000             | 106 000  | 4 700   | 10 800   | 3 700           | 5 500 | K75×82×21       | 0.088     |
|                     | 83    | 23                                         | 50 500             | 109 000  | 5 150   | 11 100   | 3 700           | 5 500 | K75×83×23       | 0.113     |
|                     | 83    | 30                                         | 67 500             | 157 000  | 6 850   | 16 100   | 3 700           | 5 500 | K75×83×30       | 0.147     |
| 80                  | 86    | 20 <sup><math>_{-0.55}^{-0.2}</math></sup> | 39 000             | 98 000   | 4 000   | 10 000   | 3 300           | 5 000 | K80×86×20       | 0.077     |
|                     | 86    | 30 <sup><math>_{-0.55}^{-0.2}</math></sup> | 57 000             | 159 000  | 5 800   | 16 200   | 3 300           | 5 000 | K80×86×30       | 0.110     |

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.



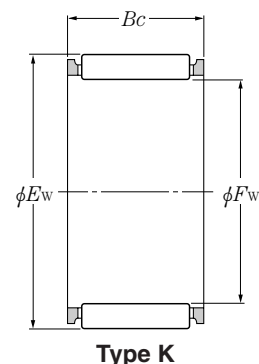


$F_w$  80~120mm

| Boundary dimensions |       |                                     | Basic load ratings |          |         |          | Limiting speeds |       | Bearing numbers | Mass      |
|---------------------|-------|-------------------------------------|--------------------|----------|---------|----------|-----------------|-------|-----------------|-----------|
|                     |       |                                     | dynamic            | static   | dynamic | static   |                 |       |                 | kg        |
| mm                  |       |                                     | N                  |          |         |          | r/min           |       |                 |           |
|                     |       |                                     | kgf                |          |         |          | grease          | oil   |                 |           |
| $F_w$               | $E_w$ | $B_c$                               | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ |                 |       |                 | (approx.) |
| 80                  | 88    | 23                                  | 53 000             | 118 000  | 5 400   | 12 100   | 3 300           | 5 000 | K80×88×23       | 0.125     |
|                     | 88    | 26 <sup>-0.2</sup> <sub>-0.55</sub> | 61 000             | 142 000  | 6 250   | 14 500   | 3 300           | 5 000 | K80×88×26       | 0.131     |
|                     | 88    | 30                                  | 69 000             | 166 000  | 7 050   | 17 000   | 3 300           | 5 000 | K80×88×30       | 0.157     |
| 85                  | 92    | 20                                  | 47 500             | 115 000  | 4 850   | 11 700   | 3 100           | 4 700 | KMJ85×92×20     | 0.083     |
|                     | 92    | 30 <sup>-0.2</sup> <sub>-0.55</sub> | 66 000             | 176 000  | 6 750   | 18 000   | 3 100           | 4 700 | K85×92×30       | 0.142     |
|                     | 93    | 27 <sup>-0.2</sup> <sub>-0.55</sub> | 64 000             | 153 000  | 6 500   | 15 600   | 3 100           | 4 700 | K85×93×27       | 0.145     |
|                     | 93    | 30                                  | 71 000             | 175 000  | 7 200   | 17 900   | 3 100           | 4 700 | K85×93×30       | 0.160     |
| 90                  | 97    | 20                                  | 46 000             | 113 000  | 4 700   | 11 500   | 2 900           | 4 400 | K90×97×20       | 0.103     |
|                     | 97    | 30                                  | 67 500             | 184 000  | 6 850   | 18 700   | 2 900           | 4 400 | K90×97×30       | 0.151     |
|                     | 98    | 26 <sup>-0.2</sup> <sub>-0.55</sub> | 64 000             | 157 000  | 6 550   | 16 000   | 2 900           | 4 400 | K90×98×26       | 0.148     |
|                     | 98    | 27                                  | 64 000             | 157 000  | 6 550   | 16 000   | 2 900           | 4 400 | K90×98×27       | 0.150     |
|                     | 98    | 30                                  | 72 500             | 184 000  | 7 400   | 18 800   | 2 900           | 4 400 | K90×98×30       | 0.172     |
| 95                  | 102   | 21                                  | 48 000             | 122 000  | 4 900   | 12 400   | 2 800           | 4 200 | K95×102×21      | 0.115     |
|                     | 102   | 31 <sup>-0.2</sup> <sub>-0.55</sub> | 70 500             | 199 000  | 7 200   | 20 300   | 2 800           | 4 200 | K95×102×31      | 0.172     |
|                     | 103   | 27 <sup>-0.2</sup> <sub>-0.55</sub> | 65 500             | 165 000  | 6 700   | 16 800   | 2 800           | 4 200 | K95×103×27      | 0.159     |
|                     | 103   | 30                                  | 74 000             | 193 000  | 7 550   | 19 600   | 2 800           | 4 200 | K95×103×30      | 0.165     |
| 100                 | 107   | 21                                  | 49 000             | 127 000  | 5 000   | 12 900   | 2 700           | 4 000 | KV100×107×21S   | 0.120     |
|                     | 107   | 31 <sup>-0.3</sup> <sub>-0.65</sub> | 71 500             | 207 000  | 7 300   | 21 100   | 2 700           | 4 000 | K100×107×31     | 0.173     |
|                     | 108   | 27 <sup>-0.3</sup> <sub>-0.65</sub> | 61 000             | 153 000  | 6 250   | 15 600   | 2 700           | 4 000 | K100×108×27     | 0.176     |
|                     | 108   | 30                                  | 76 000             | 201 000  | 7 700   | 20 500   | 2 700           | 4 000 | K100×108×30     | 0.190     |
| 105                 | 112   | 21                                  | 48 500             | 127 000  | 4 950   | 12 900   | 2 500           | 3 800 | K105×112×21     | 0.130     |
|                     | 112   | 31 <sup>-0.3</sup> <sub>-0.65</sub> | 71 000             | 207 000  | 7 250   | 21 100   | 2 500           | 3 800 | K105×112×31     | 0.176     |
|                     | 113   | 30                                  | 77 500             | 210 000  | 7 900   | 21 400   | 2 500           | 3 800 | K105×113×30     | 0.198     |
| 110                 | 117   | 24                                  | 54 500             | 149 000  | 5 550   | 15 200   | 2 400           | 3 600 | K110×117×24     | 0.145     |
|                     | 117   | 34 <sup>-0.3</sup> <sub>-0.65</sub> | 77 500             | 235 000  | 7 900   | 24 000   | 2 400           | 3 600 | K110×117×34     | 0.205     |
|                     | 118   | 30                                  | 79 000             | 219 000  | 8 050   | 22 300   | 2 400           | 3 600 | K110×118×30     | 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 | K115×123×27     | 0.200     |
|                     | 125   | 34 <sup>-0.3</sup> <sub>-0.65</sub> | 95 000             | 241 000  | 9 700   | 24 600   | 2 300           | 3 500 | K115×125×34     | 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 | K120×127×24     | 0.160     |

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



$F_w$  120~265mm

| Boundary dimensions |       |                                                          | Basic load ratings |             |                |               | Limiting speeds              |       | Bearing numbers | Mass      |
|---------------------|-------|----------------------------------------------------------|--------------------|-------------|----------------|---------------|------------------------------|-------|-----------------|-----------|
| mm                  |       |                                                          | dynamic<br>N       | static<br>N | dynamic<br>kgf | static<br>kgf | r/min<br>grease          oil |       |                 | kg        |
| $F_w$               | $E_w$ | $B_c$                                                    | $C_r$              | $C_{or}$    | $C_r$          | $C_{or}$      |                              |       |                 | (approx.) |
| 120                 | 127   | 34 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$ | 82 000             | 260 000     | 8 350          | 26 600        | 2 200                        | 3 300 | K120×127×34     | 0.235     |
| 125                 | 133   | 35 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$ | 87 000             | 260 000     | 8 900          | 26 500        | 2 100                        | 3 200 | K125×133×35     | 0.275     |
|                     | 135   | 34 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$ | 100 000            | 265 000     | 10 200         | 27 000        | 2 100                        | 3 200 | K125×135×34     | 0.350     |
| 130                 | 137   | 24 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$ | 59 000             | 175 000     | 6 000          | 17 900        | 2 100                        | 3 100 | K130×137×24     | 0.170     |
|                     | 137   | 34 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$ | 84 500             | 277 000     | 8 600          | 28 300        | 2 100                        | 3 100 | K130×137×34     | 0.240     |
| 135                 | 143   | 35 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$ | 92 500             | 288 000     | 9 450          | 29 400        | 2 000                        | 3 000 | K135×143×35     | 0.300     |
|                     | 150   | 38 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$ | 145 000            | 325 000     | 14 800         | 33 500        | 2 000                        | 3 000 | K135×150×38     | 0.590     |
| 145                 | 153   | 26 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$ | 72 000             | 214 000     | 7 350          | 21 800        | 1 900                        | 2 800 | K145×153×26     | 0.250     |
|                     | 153   | 28 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$ | 80 500             | 247 000     | 8 200          | 25 200        | 1 900                        | 2 800 | K145×153×28     | 0.252     |
|                     | 153   | 36 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$ | 100 000            | 325 000     | 10 200         | 33 000        | 1 900                        | 2 800 | K145×153×36     | 0.335     |
| 150                 | 160   | 46 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$ | 149 000            | 470 000     | 15 200         | 48 000        | 1 800                        | 2 700 | K150×160×46     | 0.550     |
| 155                 | 163   | 26 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$ | 73 500             | 224 000     | 7 500          | 22 800        | 1 700                        | 2 600 | K155×163×26     | 0.270     |
|                     | 163   | 36 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$ | 102 000            | 340 000     | 10 400         | 34 500        | 1 700                        | 2 600 | K155×163×36     | 0.355     |
| 160                 | 170   | 46 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$ | 155 000            | 505 000     | 15 800         | 51 500        | 1 700                        | 2 500 | K160×170×46     | 0.570     |
| 165                 | 173   | 26 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$ | 79 000             | 251 000     | 8 050          | 25 600        | 1 600                        | 2 400 | K165×173×26     | 0.290     |
|                     | 173   | 32 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$ | 97 000             | 330 000     | 9 900          | 33 500        | 1 600                        | 2 400 | K165×173×32     | 0.340     |
|                     | 173   | 36 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$ | 109 000            | 380 000     | 11 100         | 39 000        | 1 600                        | 2 400 | K165×173×36     | 0.375     |
| 170                 | 180   | 46 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$ | 160 000            | 540 000     | 16 400         | 55 000        | 1 600                        | 2 400 | K170×180×46     | 0.620     |
| 175                 | 183   | 32 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$ | 101 000            | 350 000     | 10 300         | 35 500        | 1 500                        | 2 300 | K175×183×32     | 0.360     |
| 185                 | 195   | 37 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$ | 131 000            | 425 000     | 13 300         | 43 500        | 1 500                        | 2 200 | K185×195×37     | 0.560     |
| 195                 | 205   | 37 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$ | 135 000            | 450 000     | 13 800         | 46 000        | 1 400                        | 2 100 | K195×205×37     | 0.620     |
| 210                 | 220   | 42 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$ | 156 000            | 560 000     | 15 900         | 57 000        | 1 300                        | 1 900 | K210×220×42     | 0.740     |
| 220                 | 230   | 42 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$ | 161 000            | 590 000     | 16 400         | 60 000        | 1 200                        | 1 800 | K220×230×42     | 0.790     |
| 240                 | 250   | 42 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$ | 167 000            | 635 000     | 17 000         | 64 500        | 1 100                        | 1 700 | K240×250×42     | 0.850     |
| 265                 | 280   | 50 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$ | 256 000            | 850 000     | 26 100         | 87 000        | 1 000                        | 1 500 | K265×280×50     | 1.810     |

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.

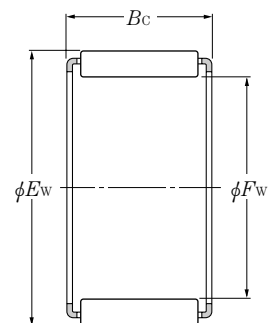
$F_w$  285mm

| Boundary dimensions |          |                                     | Basic load ratings |         |         |        | Limiting speeds |       | Bearing numbers | Mass      |
|---------------------|----------|-------------------------------------|--------------------|---------|---------|--------|-----------------|-------|-----------------|-----------|
| mm                  |          |                                     | dynamic            | static  | dynamic | static | r/min           |       |                 | kg        |
| $F_w$               | $E_w$    | $B_c$                               |                    |         |         |        | grease          | oil   |                 | (approx.) |
| $C_r$               | $C_{or}$ | $C_r$                               | $C_{or}$           |         |         |        |                 |       |                 |           |
| 285                 | 300      | 50 <sup>-0.3</sup> <sub>-0.65</sub> | 268 000            | 930 000 | 27 300  | 94 500 | 950             | 1 400 | K285×300×50     | 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

| Boundary dimensions               |                           |                                             | Basic load ratings    |                         |                         |                           | Limiting speeds |              | Bearing numbers  | Mass<br>kg<br>(approx.) |
|-----------------------------------|---------------------------|---------------------------------------------|-----------------------|-------------------------|-------------------------|---------------------------|-----------------|--------------|------------------|-------------------------|
| $F_w$                             | mm<br>$E_w$               | $B_c$<br>${}^{0}_{-0.35} ({}^{0}_{-0.014})$ | dynamic<br>N<br>$C_r$ | static<br>N<br>$C_{or}$ | dynamic<br>kgf<br>$C_r$ | static<br>kgf<br>$C_{or}$ | grease<br>r/min | oil<br>r/min |                  |                         |
| <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                | 60 000                  | 4 500                   | 6 100                     | 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)                                    | 45 500                | 64 500                  | 4 650                   | 6 600                     | 8 500           | 13 000       | <b>PCJ202616</b> | 0.062                   |
|                                   | 41.275( $1\frac{5}{8}$ )  | 38.10( $1\frac{1}{2}$ )                     | 65 000                | 102 000                 | 6 650                   | 10 400                    | 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                   |
| <b>38.100</b> ( $1\frac{1}{2}$ )  | 47.625( $1\frac{7}{8}$ )  | 25.40(1)                                    | 51 000                | 78 500                  | 5 200                   | 8 000                     | 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                   |
|                                   | 47.625( $1\frac{7}{8}$ )  | 38.10( $1\frac{1}{2}$ )                     | 72 500                | 124 000                 | 7 400                   | 12 600                    | 6 500           | 10 000       | <b>PCJ243024</b> | 0.114                   |
| <b>44.450</b> ( $1\frac{3}{4}$ )  | 53.975( $2\frac{1}{8}$ )  | 25.40(1)                                    | 56 000                | 92 500                  | 5 700                   | 9 450                     | 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                   |
|                                   | 53.975( $2\frac{1}{8}$ )  | 38.10( $1\frac{1}{2}$ )                     | 79 500                | 145 000                 | 8 100                   | 14 800                    | 6 000           | 9 000        | <b>PCJ283424</b> | 0.132                   |
| <b>50.800</b> (2)                 | 60.325( $2\frac{3}{8}$ )  | 25.40(1)                                    | 58 500                | 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                   |
|                                   | 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> | 0.087                   |
| <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                   |

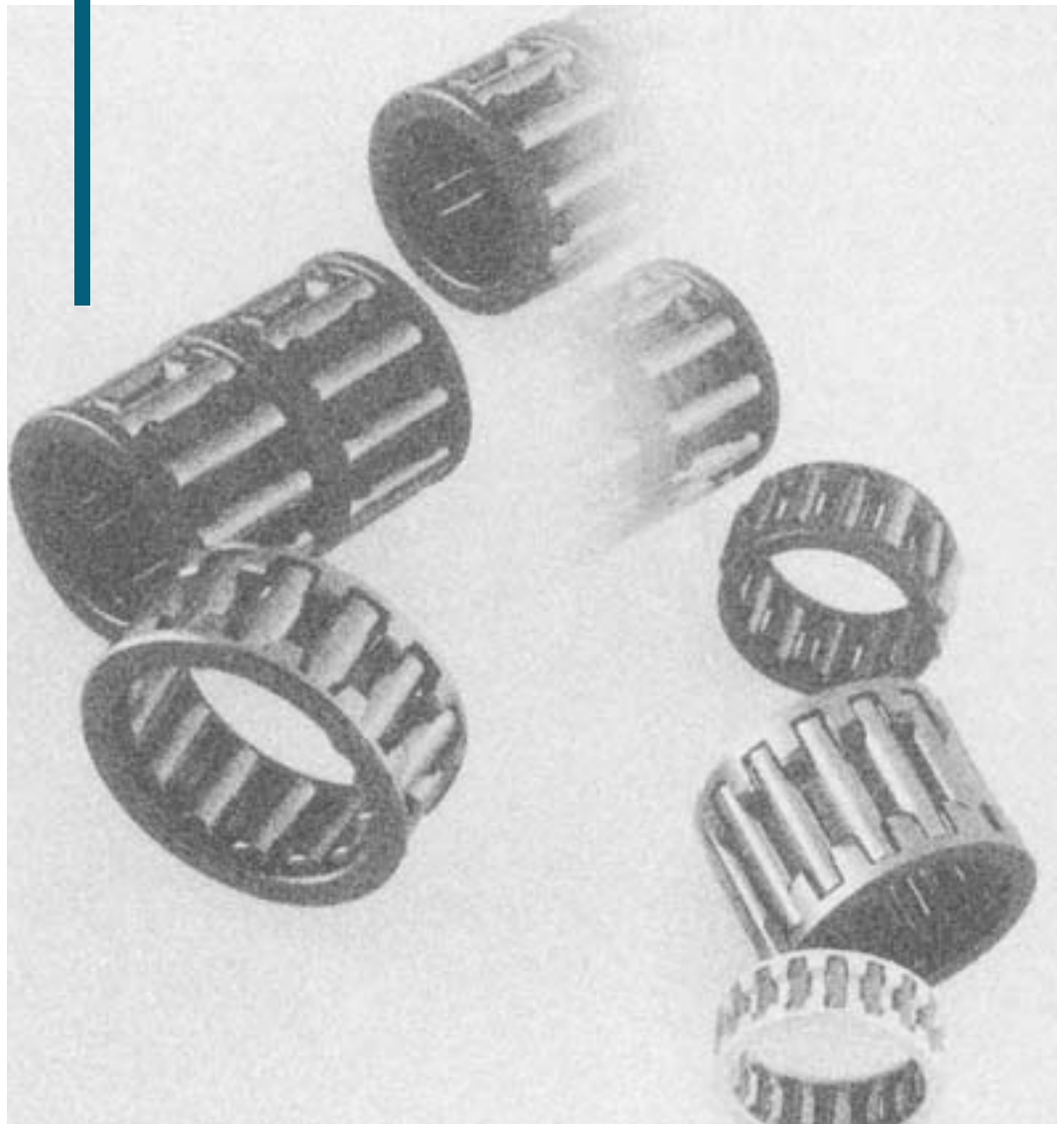
$F_w$  63.500~101.600mm

| Boundary dimensions |             |                                                             | Basic load ratings    |                    |                         |                    | Limiting speeds     |  | Bearing numbers  | Mass<br>kg<br>(approx.) |
|---------------------|-------------|-------------------------------------------------------------|-----------------------|--------------------|-------------------------|--------------------|---------------------|--|------------------|-------------------------|
| $F_w$               | mm<br>$E_w$ | $B_c$<br>$-\frac{0}{-0.35} \left( \frac{0}{-0.014} \right)$ | dynamic<br>N<br>$C_r$ | static<br>$C_{or}$ | dynamic<br>kgf<br>$C_r$ | static<br>$C_{or}$ | r/min<br>grease 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

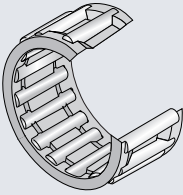
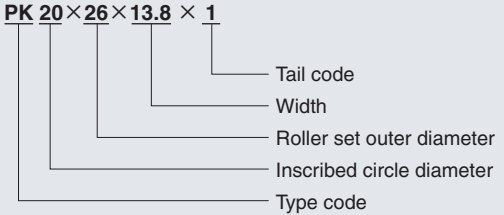
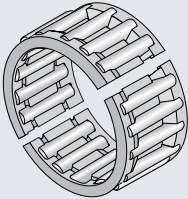
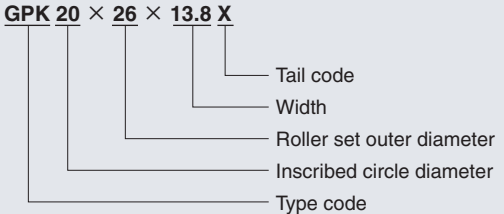
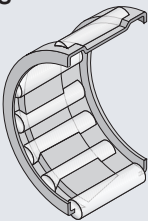
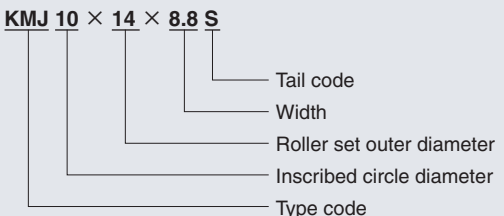
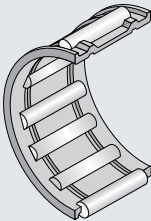
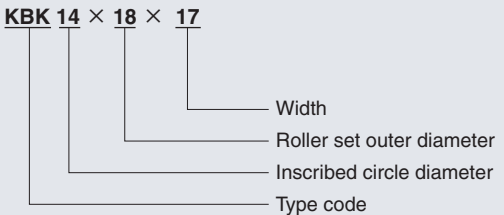
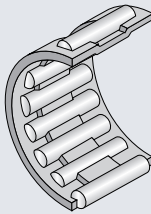
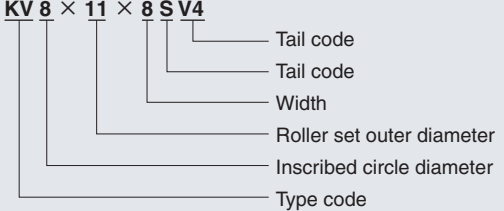


## Needle Roller and Cage Assemblies for connecting rod bearings

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          | Applied shaft diameter (mm) | Composition of nominal bearing number                                                                              |
|-------------------------------------------------------------------------------------------------------|----------------|--------------------|-----------------------------|--------------------------------------------------------------------------------------------------------------------|
| <b>PK</b><br>        | Large end side | Machined ring type | $\phi 10 \sim \phi 38$      | <b>PK 20 × 26 × 13.8 × 1</b><br> |
| <b>GPK</b><br>      |                |                    | $\phi 10 \sim \phi 38$      | <b>GPK 20 × 26 × 13.8 X</b><br> |
| <b>KMJ · S</b><br> |                | Welded type        | $\phi 10 \sim \phi 38$      | <b>KMJ 10 × 14 × 8.8 S</b><br> |
| <b>KBK</b><br>     | Small end side | Machined ring type | $\phi 7 \sim \phi 25$       | <b>KBK 14 × 18 × 17</b><br>    |
| <b>KV · S</b><br>  |                | Welded type        | $\phi 7 \sim \phi 100$      | <b>KV 8 × 11 × 8 S V4</b><br>  |

| Nominal bearing number | Code items and respective dimensions                                                                                               | Remarks                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PK20×26×13.8×1         | Inscribed circle diameter : $\phi$ 20<br>Roller set outer diameter : $\phi$ 26<br>Width : 13.8<br>X1 : numbering up                | Cage intended to guide outer ring, eventually surface- treated by non-ferrous plating, etc.                                                                                                                                                                                                                                                                                                 |
| GPK20×26×13.8X         | Inscribed circle diameter : $\phi$ 20<br>Roller set outer diameter : $\phi$ 26<br>Width : 13.8                                     | Cage intended to guide outer ring, eventually surface- treated by non-ferrous plating, etc.<br><br>Can be applied to a crank of integral structure.                                                                                                                                                                                                                                         |
| KMJ10×14×8.8S          | Inscribed circle diameter : $\phi$ 10<br>Roller set outer diameter : $\phi$ 14<br>Width : 8.8<br>S : welded type                   | Cage intended to guide outer ring, eventually surface- treated by non-ferrous plating, etc.                                                                                                                                                                                                                                                                                                 |
| KBK14×18×17            | Inscribed circle diameter : $\phi$ 14<br>Roller set outer diameter : $\phi$ 18<br>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            | Inscribed circle diameter : $\phi$ 8<br>Roller set outer diameter : $\phi$ 11<br>Width : 8<br>S : welded type<br>V4 : numbering up |                                                                                                                                                                                                                                                                                                                                                                                             |

## 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<br>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<br>sorting class | Hole diameter<br>sorting class         | 0~+4  | +4~+8 | +8~+13 |
|-------------------------------|----------------------------------------|-------|-------|--------|
|                               | Sorting class of<br>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     |

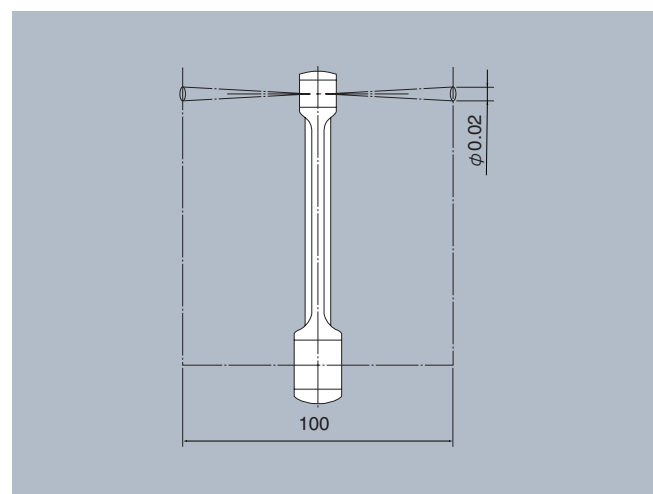


**Fig. 1**

### 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.

may be omitted.

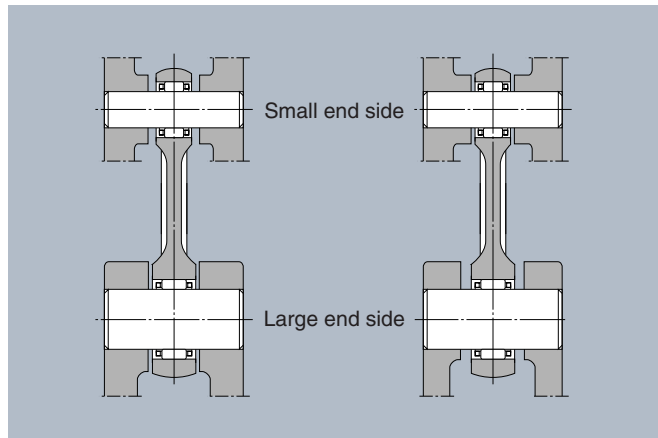
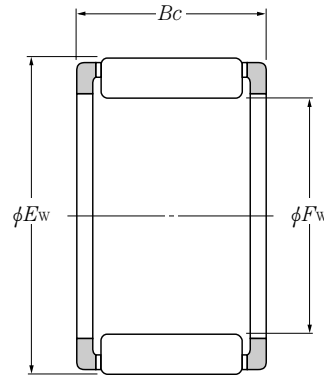


Fig. 2. Regulation at large end side    Fig. 3 Regulation at small end side

## For crank-pin

## Type PK


 $F_w$  10~30mm

| Boundary dimensions |             |             | Basic load ratings |             |                |               | Bearing numbers | Mass<br>kg<br>(approx.) |
|---------------------|-------------|-------------|--------------------|-------------|----------------|---------------|-----------------|-------------------------|
| $F_w$               | $E_w$<br>mm | $B_c$<br>mm | dynamic<br>N       | static<br>N | dynamic<br>kgf | static<br>kgf |                 |                         |
|                     |             |             | $C_r$              | $C_{or}$    | $C_r$          | $C_{or}$      |                 |                         |
| 10                  | 14          | 9.8         | 5 050              | 4 900       | 515            | 500           | PK10×14× 9.8X1  | 0.0037                  |
| 12                  | 16          | 10          | 5 450              | 5 600       | 555            | 570           | PK12×16×10.2    | 0.0044                  |
|                     | 17          | 9.8         | 6 800              | 6 550       | 695            | 670           | PK12×17× 9.8X2  | 0.0051                  |
| 14                  | 19          | 9.7         | 7 300              | 7 400       | 745            | 755           | PK14×19× 9.7X1  | 0.0065                  |
| 15                  | 20          | 9.8         | 7 250              | 7 450       | 740            | 760           | PK15×20× 9.8X   | 0.0067                  |
|                     | 21          | 11.8        | 10 000             | 10 200      | 1 020          | 1 040         | PK15×21×11.8X1  | 0.0096                  |
| 16                  | 22          | 11.8        | 10 000             | 10 300      | 1 020          | 1 050         | PK16×22×11.8X2  | 0.0097                  |
|                     | 22          | 13.2        | 10 900             | 11 500      | 1 110          | 1 170         | PK16×22×13.2X   | 0.0110                  |
| 18                  | 24          | 11.8        | 11 300             | 12 400      | 1 150          | 1 260         | PK18×24×11.8X3  | 0.0110                  |
|                     | 24          | 13.3        | 13 300             | 15 300      | 1 360          | 1 560         | PK18×24×13.3X1  | 0.0120                  |
| 19                  | 24          | 13.9        | 11 900             | 15 200      | 1 220          | 1 550         | PK19×24×13.9X   | 0.0110                  |
|                     | 25          | 15.8        | 14 300             | 17 000      | 1 460          | 1 730         | PK19×25×15.8X1  | 0.0150                  |
| 20                  | 26          | 13.8        | 14 000             | 16 700      | 1 420          | 1 700         | PK20×26×13.8X6  | 0.0140                  |
| 22                  | 28          | 15.8        | 15 900             | 20 200      | 1 620          | 2 060         | PK22×28×15.8X1  | 0.0170                  |
|                     | 29          | 17.8        | 18 800             | 22 800      | 1 920          | 2 320         | PK22×29×17.8X7  | 0.0240                  |
|                     | 30          | 14.7        | 16 900             | 18 200      | 1 720          | 1 860         | PK22×30×14.7X2  | 0.0240                  |
|                     | 30          | 17.8        | 21 900             | 25 400      | 2 230          | 2 590         | PK22×30×17.8X2  | 0.0270                  |
| 24                  | 31          | 16.8        | 20 800             | 26 600      | 2 120          | 2 710         | PK24×31×16.8X7  | 0.0240                  |
|                     | 32          | 19.8        | 22 900             | 27 500      | 2 340          | 2 810         | PK24×32×19.8X6  | 0.0330                  |
| 26                  | 31          | 13.8        | 14 200             | 20 900      | 1 450          | 2 130         | PK26×31×13.8X2  | 0.0150                  |
|                     | 34          | 16.8        | 21 600             | 26 100      | 2 200          | 2 660         | PK26×34×16.8X7  | 0.0320                  |
| 27                  | 36          | 20.8        | 30 500             | 38 500      | 3 150          | 3 950         | PK27×36×20.8X1  | 0.0440                  |
| 28                  | 36          | 15.8        | 23 700             | 30 000      | 2 410          | 3 050         | PK28×36×15.8X6  | 0.0310                  |
|                     | 37          | 20.8        | 32 500             | 41 500      | 3 300          | 4 250         | PK28×37×20.8X   | 0.0480                  |
| 29                  | 39          | 21.4        | 32 500             | 39 500      | 3 300          | 4 000         | PK29×39×21.4X2  | 0.0550                  |
| 30                  | 37          | 15.9        | 21 900             | 30 500      | 2 230          | 3 100         | PK30×37×15.9X   | 0.0280                  |
|                     | 38          | 15.8        | 24 600             | 32 000      | 2 510          | 3 300         | PK30×38×15.8X   | 0.0320                  |

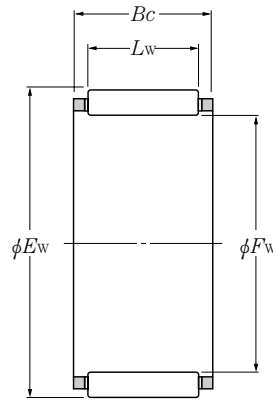


$F_w$  30~38mm

| Boundary dimensions |             |                    | Basic load ratings    |                    |                         |                    | Bearing numbers | Mass<br>kg<br>(approx.) |
|---------------------|-------------|--------------------|-----------------------|--------------------|-------------------------|--------------------|-----------------|-------------------------|
| $F_w$               | mm<br>$E_w$ | $B_c$<br>0<br>-0.2 | dynamic<br>N<br>$C_r$ | static<br>$C_{or}$ | dynamic<br>kgf<br>$C_r$ | static<br>$C_{or}$ |                 |                         |
| 30                  | 38          | 17.8               | 27 700                | 37 500             | 2 820                   | 3 800              | PK30×38×17.8X1  | 0.037                   |
| 31                  | 41          | 21.4               | 34 000                | 43 000             | 3 500                   | 4 350              | PK31×41×21.4X   | 0.057                   |
| 32                  | 43          | 22.4               | 40 000                | 49 500             | 4 100                   | 5 050              | PK32×43×22.4X   | 0.069                   |
| 34                  | 42          | 19.8               | 31 500                | 45 500             | 3 200                   | 4 650              | PK34×42×19.8X   | 0.046                   |
| 38                  | 47          | 19.8               | 35 500                | 51 000             | 3 600                   | 5 200              | PK38×47×19.8X1  | 0.056                   |

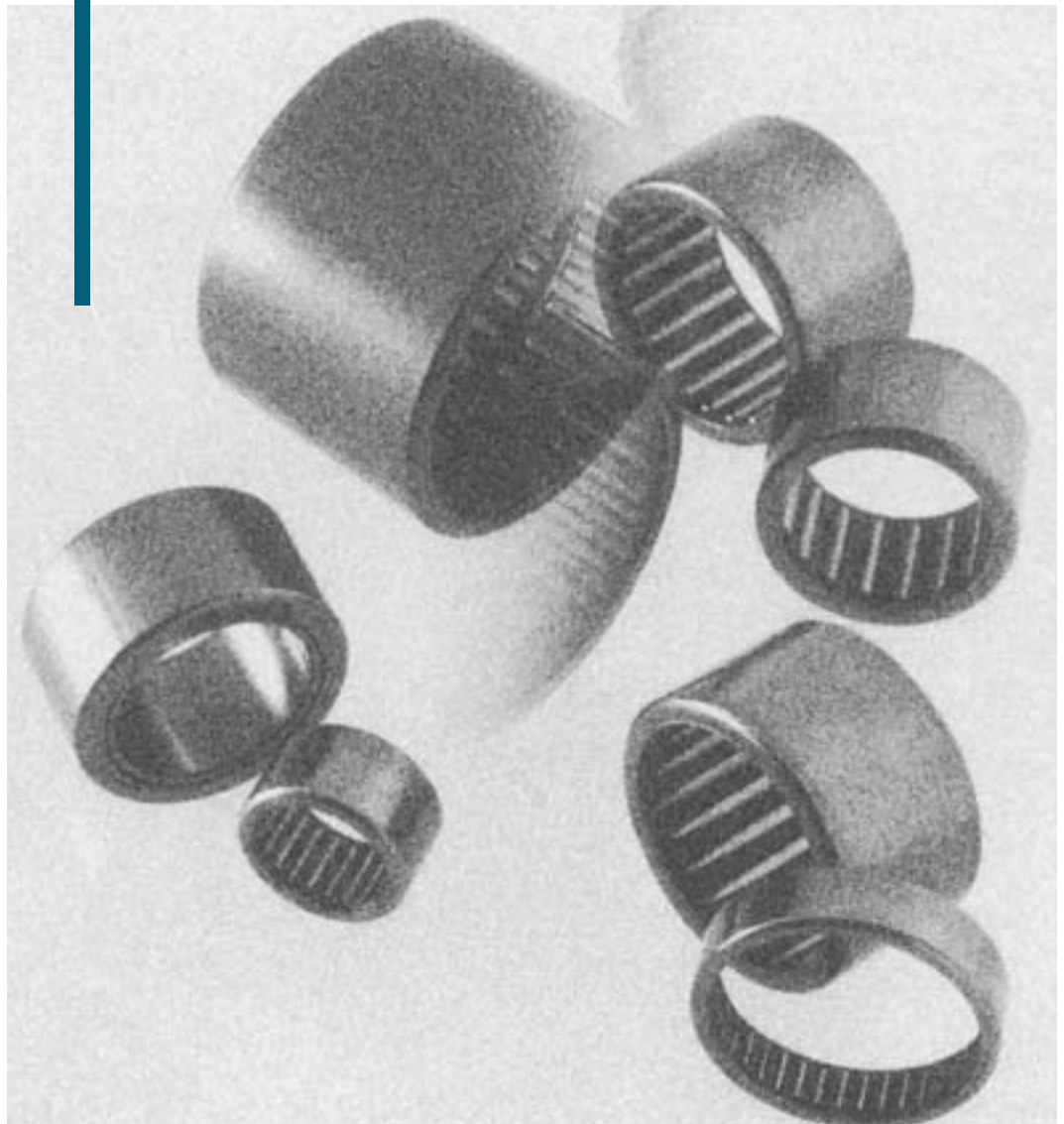
## For piston-pin

## Type KBK


 $F_w$  7~22mm

| Boundary dimensions |       |                          |       | Basic load ratings    |                    |                         |                    | Bearing numbers  | Mass<br>kg<br>(approx.) |
|---------------------|-------|--------------------------|-------|-----------------------|--------------------|-------------------------|--------------------|------------------|-------------------------|
| $F_w$               | $E_w$ | mm<br>$B_c$<br>0<br>-0.2 | $L_w$ | dynamic<br>N<br>$C_r$ | static<br>$C_{or}$ | dynamic<br>kgf<br>$C_r$ | static<br>$C_{or}$ |                  |                         |
| 7                   | 10    | 9.8                      | 6.8   | 3 050                 | 2 780              | 310                     | 284                | KBK 7×10× 9.8X   | 0.0022                  |
| 8                   | 11    | 11.8                     | 8.8   | 4 100                 | 4 200              | 415                     | 430                | KBK 8×11× 11.8X1 | 0.0028                  |
| 9                   | 12    | 11.5                     | 8.8   | 4 400                 | 4 750              | 450                     | 485                | KBK 9×12× 11.7   | 0.0030                  |
| 10                  | 14    | 9.8                      | 6.8   | 4 500                 | 4 200              | 460                     | 430                | KBK10×14× 9.8X   | 0.0042                  |
|                     | 14    | 12.5                     | 9.8   | 6 100                 | 6 200              | 620                     | 635                | KBK10×14× 12.5X1 | 0.0053                  |
|                     | 14    | 14.8                     | 9.8   | 6 100                 | 6 200              | 620                     | 635                | KBK10×14× 14.8X  | 0.0064                  |
| 11                  | 14    | 13.5                     | 10.8  | 5 850                 | 7 250              | 595                     | 740                | KBK11×14× 13.5X1 | 0.0044                  |
| 12                  | 15    | 16.4                     | 13.8  | 7 500                 | 10 200             | 765                     | 1 040              | KBK12×15× 16.6   | 0.0055                  |
|                     | 16    | 14.8                     | 11.8  | 7 600                 | 8 600              | 775                     | 875                | KBK12×16× 14.8X  | 0.0072                  |
|                     | 16    | 15.4                     | 9.8   | 7 000                 | 7 800              | 715                     | 795                | KBK12×16× 15.6   | 0.0079                  |
|                     | 16    | 15.8                     | 12.8  | 8 100                 | 9 350              | 825                     | 955                | KBK12×16× 16     | 0.0073                  |
|                     | 17    | 14.8                     | 9.8   | 8 400                 | 8 550              | 855                     | 875                | KBK12×17× 14.8X  | 0.0094                  |
| 14                  | 18    | 16.8                     | 13.8  | 9 750                 | 12 400             | 995                     | 1 260              | KBK14×18× 17     | 0.0089                  |
|                     | 18    | 19.8                     | 13.8  | 9 150                 | 11 300             | 930                     | 1 160              | KBK14×18× 20     | 0.0130                  |
|                     | 19    | 17.1                     | 12.8  | 11 100                | 12 700             | 1 130                   | 1 300              | KBK14×19× 17.1X  | 0.0120                  |
| 15                  | 19    | 17.3                     | 13.8  | 10 900                | 14 600             | 1 110                   | 1 490              | KBK15×19× 17.3X  | 0.0100                  |
| 16                  | 20    | 16.8                     | 13.8  | 10 800                | 14 700             | 1 100                   | 1 500              | KBK16×20× 17     | 0.0100                  |
|                     | 20    | 19.6                     | 13.8  | 10 200                | 13 600             | 1 040                   | 1 390              | KBK16×20× 19.8   | 0.0130                  |
|                     | 20    | 23.8                     | 19.8  | 13 600                | 19 700             | 1 390                   | 2 010              | KBK16×20× 23.8X  | 0.0150                  |
|                     | 21    | 19.6                     | 15.8  | 13 900                | 17 600             | 1 420                   | 1 790              | KBK16×21× 19.6X  | 0.0160                  |
| 17                  | 21    | 23                       | 15.8  | 13 200                | 19 400             | 1 340                   | 1 980              | KBK17×21× 23.2   | 0.0160                  |
|                     | 21    | 25                       | 17.8  | 13 100                | 19 200             | 1 340                   | 1 960              | KBK17×21× 25X    | 0.0170                  |
|                     | 22    | 22                       | 18.8  | 16 900                | 22 900             | 1 720                   | 2 340              | KBK17×22× 22X1   | 0.0170                  |
| 18                  | 22    | 21.8                     | 15.8  | 12 500                | 18 300             | 1 270                   | 1 870              | KBK18×22× 21.8X3 | 0.0150                  |
|                     | 22    | 23.8                     | 17.8  | 13 000                | 19 300             | 1 330                   | 1 970              | KBK18×22× 23.8X1 | 0.0160                  |
| 20                  | 25    | 27.9                     | 21.8  | 20 800                | 31 500             | 2 120                   | 3 200              | KBK20×25× 27.9X  | 0.0270                  |
| 22                  | 28    | 29.9                     | 23.8  | 26 000                | 38 000             | 2 650                   | 3 900              | KBK22×28× 29.9X1 | 0.0390                  |

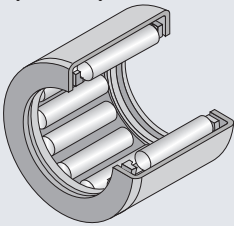
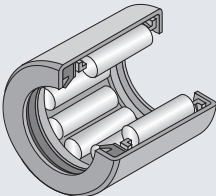
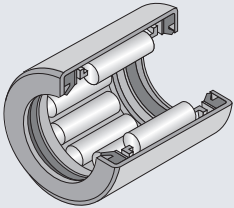
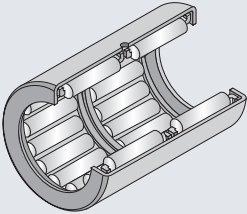
## Drawn Cup Needle Roller Bearings

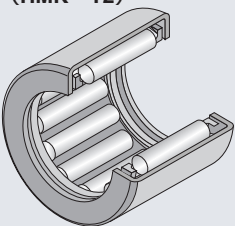
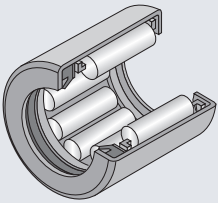
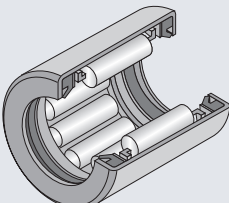
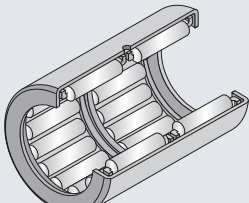


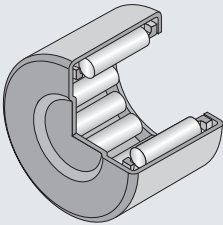
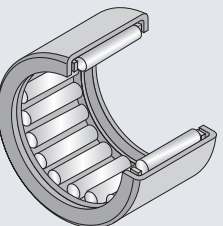
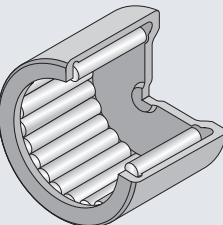
## Drawn Cup Needle Roller Bearings

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. 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                                                                                                   |                 | Applied shaft diameter (mm) | Composition of nominal bearing number                                                                                                                             | Nominal bearing number | Code items and dimensions                                                                                   | Remarks                                                                                                                                                                                                                                                                               |
|-------------------------------------------------------------------------------------------------------------------|-----------------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>HK</b><br><b>(HK··T2)</b><br> | Standard series | Open end                    | $\phi 3 \sim \phi 50$<br><b>HK 06 09 T2</b><br>Tail code<br>Width<br>Inscribed circle diameter<br>Type code<br>[Tail code]<br>T2 : Resin cage<br>C : Welding cage | HK0609T2               | Inscribed circle diameter : $\phi 6$<br>Width : 9<br>T2 : Resin cage                                        | The bearings with tail code T2 using polyamide resin cage shall be used at allowable temperature 120°C and, under continuous running, at 100°C and less.                                                                                                                              |
| <b>HK··L</b><br>                |                 | Open end single side seal   | $\phi 12 \sim \phi 50$<br><b>HK 20 18 L</b><br>Tail code<br>Width<br>Inscribed circle diameter<br>Type code                                                       | HK2018L                | Inscribed circle diameter : $\phi 20$<br>Width : 18<br>L : single side seal                                 | 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. The operating temperature shall range from -25 to 100°C maximum to prevent deterioration of the seal and filled-up grease. |
| <b>HK··LL</b><br>              |                 | Open end double-side seal   | $\phi 12 \sim \phi 50$<br><b>HK 20 20 LL</b><br>Tail code<br>Width<br>Inscribed circle diameter<br>Type code                                                      | HK2020LL               | Inscribed circle diameter : $\phi 20$<br>Width : 20<br>LL: Double-side seal                                 | 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><br>             |                 | Open end double-row type    | $\phi 15 \sim \phi 30$<br><b>HK 20 30 ZW D</b><br>Tail code<br>Tail code<br>Width<br>Inscribed circle diameter<br>Type code                                       | HK2030ZWD              | Inscribed circle diameter : $\phi 20$<br>Width : 30<br>ZW : Double-row cage<br>D : Outer ring with oil hole | This type is provided with oil hole on its outer ring.                                                                                                                                                                                                                                |

| Type of bearing                                                                                                 |                   | Applied shaft diameter (mm) | Composition of nominal bearing number | Nominal bearing number                                                                             | Code items and dimensions | Remarks                                                                                                                                                                                                                                                                                                                                                                  |
|-----------------------------------------------------------------------------------------------------------------|-------------------|-----------------------------|---------------------------------------|----------------------------------------------------------------------------------------------------|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>HMK</b><br><b>(HMK··T2)</b>  | Heavy load series | Open end                    | $\phi 8 \sim \phi 50$                 | <b>HMK 20 15</b><br>Type code<br>Inscribed circle diameter<br>Width                                | HMK2015                   | Inscribed circle diameter : $\phi 20$<br>Width : 15<br><br>The bearings with tail code T2 using polyamide resin cage shall be used at allowable temperature 120°C and, under continuous running, at 100°C and less.                                                                                                                                                      |
| <b>HMK··L</b>                  |                   | Open end single side seal   | $\phi 8 \sim \phi 50$                 | <b>HMK 20 18 L</b><br>Type code<br>Inscribed circle diameter<br>Width<br>Tail code                 | HMK2018L                  | Inscribed circle diameter : $\phi 20$<br>Width : 18<br>L : single side seal<br><br>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. The operating temperature shall range from -25 to 100°C maximum to prevent deterioration of the seal and filled-up grease. |
| <b>HMK··LL</b>                |                   | Open end double-side seal   | $\phi 8 \sim \phi 50$                 | <b>HMK 20 21 LL</b><br>Type code<br>Inscribed circle diameter<br>Width<br>Tail code                | HMK2021LL                 | Inscribed circle diameter : $\phi 20$<br>Width : 21<br>LL: Double-side seal<br><br>The roller length and rated load of this bearing type are shorter and smaller than those of the open type of same dimension.                                                                                                                                                          |
| <b>HMK··ZWD</b>               |                   | Open end double-row type    | $\phi 38 \sim \phi 50$                | <b>HMK 38 45 ZW D</b><br>Type code<br>Inscribed circle diameter<br>Width<br>Tail code<br>Tail code | HK3845ZWD                 | Inscribed circle diameter : $\phi 38$<br>Width : 45<br>ZW : Double-row cage<br>D : Outer ring with oil hole<br><br>This type is provided with oil hole on its outer ring.                                                                                                                                                                                                |

| Type of bearing                                                                                                   |                                            | Applied shaft diameter (mm) | Composition of nominal bearing number                                                                                                                     | Nominal bearing number | Code items and dimensions                                                                                   | Remarks                                                                                                                                                                                                         |
|-------------------------------------------------------------------------------------------------------------------|--------------------------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>BK</b><br><b>(BK··T2)</b><br> | <b>Standard series</b>                     | Closed end                  | $\phi 3 \sim \phi 50$<br><b>BK 20 20 C</b><br>————— Tail code<br>————— Width<br>————— Inscribed circle diameter<br>————— Type code                        | BK2020C                | Inscribed circle diameter : $\phi 20$<br>Width : 20<br>C : Welding cage                                     | The bearings with tail code T2 using polyamide resin cage shall be used at allowable temperature 120°C and, under continuous running, at 100°C and less.                                                        |
|                                                                                                                   |                                            | Closed end single side seal | $\phi 12 \sim \phi 50$<br><b>BK 20 18 L</b><br>————— Tail code<br>————— Width<br>————— Inscribed circle diameter<br>————— Type code                       | BK2018L                | Inscribed circle diameter : $\phi 20$<br>Width : 18<br>L : single side seal                                 | This seal type (Tail code: L) is internally filled up with lithium soap base grease. The operating temperature shall range from -25 to 100°C maximum to prevent deterioration of the seal and filled-up grease. |
|                                                                                                                   |                                            | Closed end double-row type  | $\phi 15 \sim \phi 30$<br><b>BK 20 30 ZW D</b><br>————— Tail code<br>————— Tail code<br>————— Width<br>————— Inscribed circle diameter<br>————— Type code | BK2030ZWD              | Inscribed circle diameter : $\phi 20$<br>Width : 30<br>ZW : Double-row cage<br>D : Outer ring with oil hole | Inscribed circle diameter                                                                                                                                                                                       |
| <b>DCL</b><br>                 | <b>Inch series</b>                         | Open end                    | $\phi 6.35 \sim \phi 50.8$<br><b>DCL 16 20</b><br>————— Width code<br>————— Inscribed circle diameter code<br>————— Type code                             | DCL1620                | Inscribed circle diameter : $\phi 25.4$<br>Width : 31.75                                                    |                                                                                                                                                                                                                 |
| <b>HCK</b><br>                 | <b>Bearing series for universal joints</b> | Closed end                  | $\phi 10 \sim \phi 20$<br><b>HCK 16 22</b><br>————— Outer diameter<br>————— Inscribed circle diameter<br>————— Type code                                  | HCK1622                | Inscribed circle diameter : $\phi 16$<br>Width : $\phi 22$                                                  | Full complement roller type with no cage. Already filled up with specific grease.                                                                                                                               |

## 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**

| 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 bore

Because of its thin-walled outer ring, the performance of drawn cup needle roller bearing is greatly affected by the dimensional accuracy, profile accuracy and bore surface roughness of a housing in which the bearing is press-fitted. To avoid such an inverse affect, the housing bore(hole) must have the accuracy as specified in **Table 2**. For the shaft accuracy refer to **Subsection 7.3 "Accuracy of Shaft and Housing"** (on page A-39).

**Table 2 Accuracy of housing bore**

| 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)**

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

## Bearing installation

Any drawn cup needle roller bearings must be press-fitted in the housing in specific position by holding a specific jig in perfect contact with the mark-stamped side face of the bearing, without fail.

**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.**

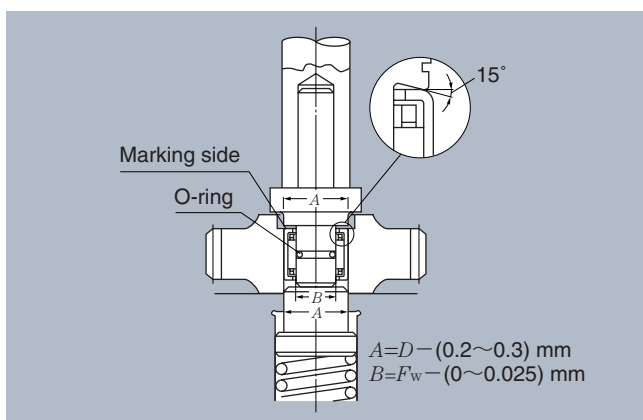


**Fig. 1**

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).

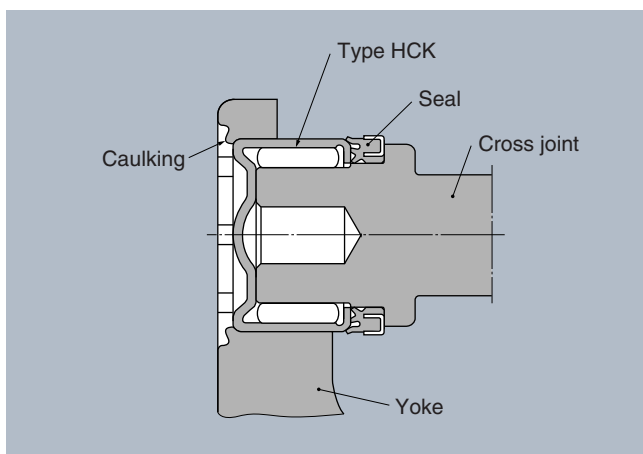


**Fig. 2**



## 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.

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 inscribed circle 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 inscribed circle diameter of roller, the low tolerance for the inscribed circle diameter shall be applied to the dimension at "GO" side and the value of the high tolerance for the inscribed circle diameter plus (+)  $2\mu\text{m}$  shall be applied to the dimension at "NOT GO" side in compliance with the relevant ISO standard.

Table 4 Dimensional tolerance for inscribed circle diameter (Type HK and BK)

Unit : mm

| Nominal inscribed circle dia.<br>$F_w$ | Nominal outer ring outer dia.<br>$D$ | 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 |
| 55                                     | 63                                   | 62.967               | 55.060                                  | 55.030 |
| 60                                     | 68                                   | 67.967               | 60.060                                  | 60.030 |

Table 5 Dimensional tolerance for inscribed circle diameter (Type HMK)

Unit : mm

| Nominal inscribed circle dia.<br>$F_w$ | Nominal outer ring outer dia.<br>$D$ | 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 |

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

| Nominal inscribed<br>circle dia.<br>$F_w$ | Nominal outer<br>ring outer dia.<br>$D$ | Ring gauge<br>bore dia. | Tolerance for<br>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 |

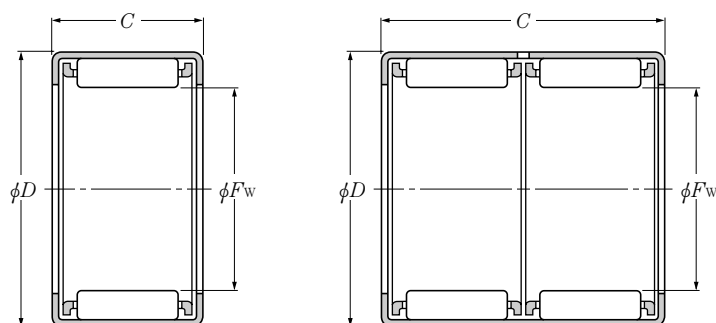
**Table 7 Dimensional tolerance for inscribed circle diameter (Type HCK)**  
Unit : mm

| Nominal inscribed<br>circle dia.<br>$F_w$ | Nominal outer<br>ring outer dia.<br>$D$ | Ring gauge<br>bore dia. | Tolerance for<br>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 |

Type HK, Type HK · · ZWD

Type HMK

Type BK, Type BK · · ZWD



Type HK, Type HMK

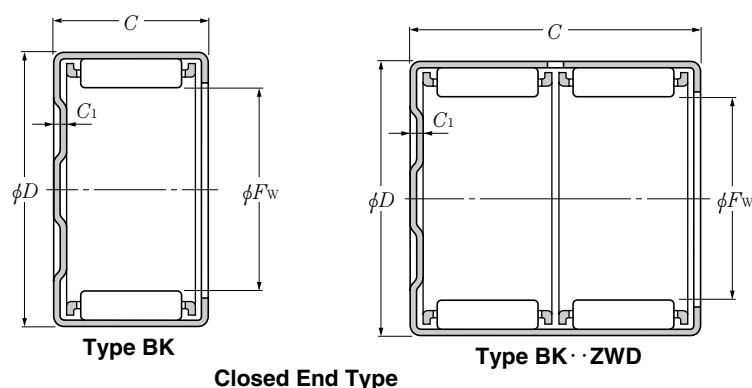
Type HK · · ZWD

Opened End Type

$F_w$  3~10mm

| Boundary dimensions |     |                  |              | Basic load ratings |        |         |        | Limiting speeds |        | Bearing numbers    |                      | Mass            | Appropriate <sup>1)</sup><br>inner ring |
|---------------------|-----|------------------|--------------|--------------------|--------|---------|--------|-----------------|--------|--------------------|----------------------|-----------------|-----------------------------------------|
| mm                  |     |                  |              | dynamic            | static | dynamic | static | r/min           |        | open end<br>design | closed end<br>design | kg<br>(approx.) | (as a reference)                        |
| $F_w$               | $D$ | $C$<br>0<br>-0.2 | $C_1$<br>max | N                  |        | kgf     |        | grease          | oil    |                    |                      |                 |                                         |
| 3                   | 6.5 | 6                | —            | 925                | 565    | 94      | 58     | 33 000          | 50 000 | HK0306T2           | —                    | 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 | HK0408T2           | —                    | 0.0016          | —                                       |
|                     | 8   | 8                | 1.6          | 1 770              | 1 270  | 180     | 129    | 30 000          | 45 000 | —                  | BK0408T2             | 0.0018          | —                                       |
| 5                   | 9   | 9                | —            | 2 640              | 2 190  | 269     | 224    | 27 000          | 40 000 | HK0509T2           | —                    | 0.0019          | —                                       |
|                     | 9   | 9                | 1.6          | 2 640              | 2 190  | 269     | 224    | 27 000          | 40 000 | —                  | BK0509T2             | 0.0021          | —                                       |
| 6                   | 10  | 9                | —            | 2 660              | 2 280  | 272     | 233    | 25 000          | 37 000 | HK0609T2           | —                    | 0.0022          | —                                       |
|                     | 10  | 9                | 1.6          | 2 660              | 2 280  | 272     | 233    | 25 000          | 37 000 | —                  | BK0609T2             | 0.0024          | —                                       |
| 7                   | 11  | 9                | —            | 3 400              | 3 250  | 345     | 330    | 23 000          | 34 000 | HK0709             | —                    | 0.0025          | —                                       |
|                     | 11  | 9                | 1.6          | 3 400              | 3 250  | 345     | 330    | 23 000          | 34 000 | —                  | BK0709               | 0.0027          | —                                       |
| 8                   | 12  | 10               | —            | 3 850              | 3 950  | 395     | 400    | 20 000          | 30 000 | HK0810C            | —                    | 0.0032          | IR 5× 8×12                              |
|                     | 12  | 10               | 1.6          | 3 850              | 3 950  | 395     | 400    | 20 000          | 30 000 | —                  | BK0810C              | 0.0034          | IR 5× 8×12                              |
|                     | 15  | 10               | —            | 3 800              | 2 870  | 390     | 293    | 20 000          | 30 000 | HMK0810            | —                    | 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               | —            | 4 750              | 5 300  | 485     | 540    | 18 000          | 27 000 | HK0910             | —                    | 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               | —            | 5 650              | 6 650  | 575     | 680    | 18 000          | 27 000 | HK0912             | —                    | 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 | HK1010             | —                    | 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               | —            | 5 900              | 7 250  | 605     | 735    | 16 000          | 24 000 | HK1012             | —                    | 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               | —            | 7 100              | 9 150  | 725     | 935    | 16 000          | 24 000 | HK1015             | —                    | 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-117.)  
EX. HK1012 + IR7×10×16.5



$F_w$  10~16mm

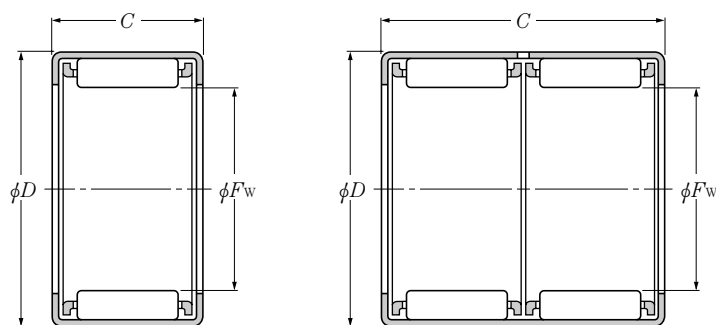
| Boundary dimensions |     |                  |              | Basic load ratings |        |         |        | Limiting speeds |        | Bearing numbers    |                      | Mass            | Appropriate <sup>1)</sup><br>inner ring |
|---------------------|-----|------------------|--------------|--------------------|--------|---------|--------|-----------------|--------|--------------------|----------------------|-----------------|-----------------------------------------|
| mm                  |     |                  |              | dynamic            | static | dynamic | static | r/min           |        | open end<br>design | closed end<br>design | kg<br>(approx.) | (as a reference)                        |
| $F_w$               | $D$ | $C$<br>0<br>-0.2 | $C_1$<br>max | N                  |        | kgf     |        | grease          | oil    |                    |                      |                 |                                         |
| <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>HK1210</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>HK1212</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          | —                                       |
|                     | 19  | 25               | —            | 15 300             | 18 600 | 1 560   | 1 890  | 13 000          | 20 000 | <b>HMK1225</b>     | —                    | 0.0230          | —                                       |
| <b>13</b>           | 19  | 12               | —            | 6 950              | 7 900  | 705     | 805    | 12 000          | 18 000 | <b>HK1312</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>HK1412</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               | —            | 10 700             | 14 000 | 1 090   | 1 430  | 11 000          | 17 000 | <b>HK1416</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>HMK1416</b>     | —                    | 0.0190          | IR10×14×20                              |
|                     | 22  | 20               | —            | 14 600             | 16 200 | 1 490   | 1 650  | 11 000          | 17 000 | <b>HMK1420</b>     | —                    | 0.0240          | —                                       |
| <b>15</b>           | 21  | 12               | —            | 7 500              | 9 100  | 765     | 930    | 11 000          | 16 000 | <b>HK1512</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>HK1516</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>HK1522ZWD</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               | —            | 10 900             | 12 700 | 1 120   | 1 300  | 11 000          | 16 000 | <b>HMK1515</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>HK1612</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-117, B118.)  
EX. HK1312 + IR10×13×12.5

Type HK, Type HK · · ZWD

Type HMK

Type BK, Type BK · · ZWD



Type HK, Type HMK

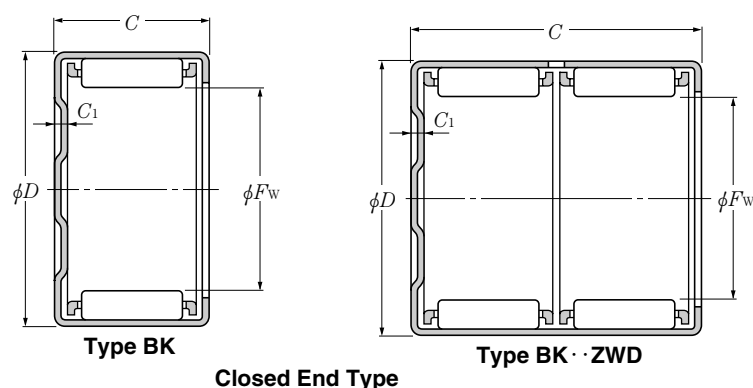
Type HK · · ZWD

Opened End Type

$F_w$  16~20mm

| Boundary dimensions |     |                  |              | Basic load ratings |        |         |        | Limiting speeds |        | Bearing numbers    |                      | Mass            | Appropriate <sup>1)</sup><br>inner ring |
|---------------------|-----|------------------|--------------|--------------------|--------|---------|--------|-----------------|--------|--------------------|----------------------|-----------------|-----------------------------------------|
| mm                  |     |                  |              | dynamic            | static | dynamic | static | r/min           |        | open end<br>design | closed end<br>design | kg<br>(approx.) | (as a reference)                        |
| $F_w$               | $D$ | $C$<br>0<br>-0.2 | $C_1$<br>max | N                  |        | kgf     |        | grease          | oil    |                    |                      |                 |                                         |
| 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 | HK1616             | —                    | 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 | HK1622ZWD          | —                    | 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 | HMK1620            | —                    | 0.027           | IR12×16×22                              |
| 17                  | 23  | 12               | —            | 8 500              | 11 100 | 865     | 1 130  | 9 500           | 14 000 | HK1712             | —                    | 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 | HMK1720C           | —                    | 0.024           | IR12×17×20.5                            |
|                     | 24  | 25               | —            | 19 300             | 27 400 | 1 970   | 2 790  | 9 500           | 14 000 | HMK1725B           | —                    | 0.030           | IR12×17×25.5                            |
| 18                  | 24  | 12               | —            | 8 300              | 10 900 | 845     | 1 110  | 8 500           | 13 000 | HK1812             | —                    | 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 | HK1816             | —                    | 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               | —            | 13 800             | 18 000 | 1 400   | 1 830  | 8 500           | 13 000 | HMK1817            | —                    | 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               | —            | 9 250              | 13 000 | 945     | 1 330  | 8 000           | 12 000 | HK2012C            | —                    | 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               | —            | 13 000             | 20 100 | 1 320   | 2 050  | 8 000           | 12 000 | HK2016             | —                    | 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               | —            | 16 400             | 27 100 | 1 670   | 2 760  | 8 000           | 12 000 | HK2020C            | —                    | 0.024           | IR17×20×20.5                            |
|                     | 26  | 20               | 2.7          | 16 400             | 27 100 | 1 670   | 2 760  | 8 000           | 12 000 | —                  | BK2020C              | 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-118, B119.)  
EX. HK1812 + IR15×18×12.5



$F_w$  20~25mm

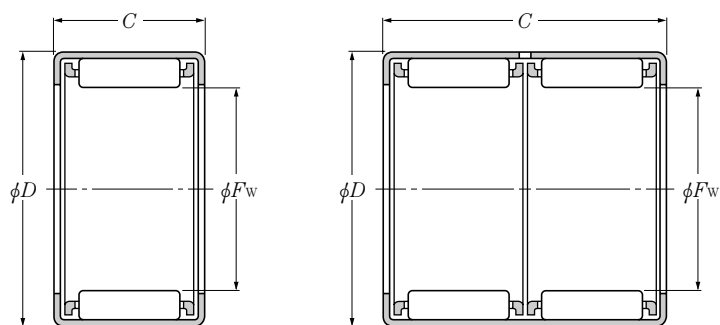
| Boundary dimensions |     |                  |              | Basic load ratings |        |         |        | Limiting speeds |        | Bearing numbers    |                      | Mass            | Appropriate <sup>1)</sup><br>inner ring |
|---------------------|-----|------------------|--------------|--------------------|--------|---------|--------|-----------------|--------|--------------------|----------------------|-----------------|-----------------------------------------|
| mm                  |     |                  |              | dynamic            | static | dynamic | static | r/min           |        | open end<br>design | closed end<br>design | kg<br>(approx.) | (as a reference)                        |
| $F_w$               | $D$ | $C$<br>0<br>-0.2 | $C_1$<br>max | N                  |        | kgf     |        | grease          | oil    |                    |                      |                 |                                         |
| 20                  | 26  | 30               | —            | 22 200             | 40 000 | 2 270   | 4 100  | 8 000           | 12 000 | HK2030ZWD          | —                    | 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               | —            | 9 750              | 14 300 | 995     | 1 460  | 7 500           | 11 000 | HK2212             | —                    | 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               | —            | 13 600             | 22 100 | 1 390   | 2 250  | 7 500           | 11 000 | HK2216C            | —                    | 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               | —            | 17 200             | 29 800 | 1 760   | 3 050  | 7 500           | 11 000 | HK2220C            | —                    | 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               | —            | 18 800             | 29 100 | 1 910   | 2 970  | 6 500           | 10 000 | HMK2420            | —                    | 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               | —            | 11 800             | 16 300 | 1 200   | 1 660  | 6 500           | 9 500  | HK2512             | —                    | 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  | HK2516             | —                    | 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-119, B120.)  
EX. HK2512 + 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

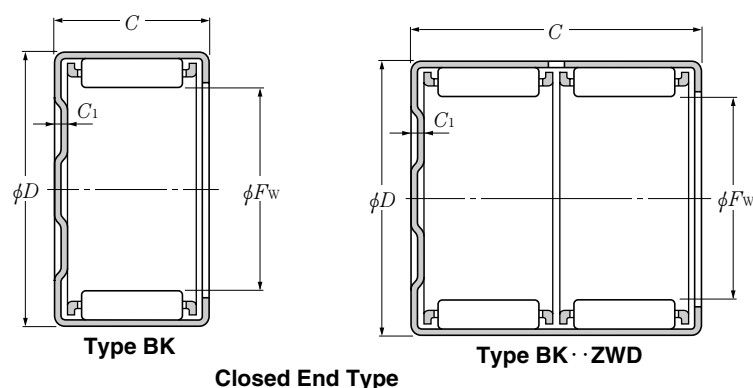
Opened End Type

$F_w$  25~30mm

| Boundary dimensions |    |    |              | Basic load ratings |             |                |               | Limiting speeds |       | Bearing numbers    |                      | Mass            | Appropriate <sup>1)</sup><br>inner ring |
|---------------------|----|----|--------------|--------------------|-------------|----------------|---------------|-----------------|-------|--------------------|----------------------|-----------------|-----------------------------------------|
| mm                  |    |    |              | dynamic<br>N       | static<br>N | dynamic<br>kgf | static<br>kgf | r/min           |       | open end<br>design | closed end<br>design | kg<br>(approx.) | (as a reference)                        |
| $F_w$               | D  | C  | $C_1$<br>max | $C_r$              | $C_{or}$    | $C_r$          | $C_{or}$      | grease          | oil   |                    |                      |                 |                                         |
| 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 | HMK2515C           | —                    | 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 | —            | 17 200             | 23 300      | 1 750          | 2 380         | 6 000           | 9 000 | HMK2616            | —                    | 0.032           | IR22×26×20                              |
|                     | 34 | 20 | —            | 21 800             | 31 500      | 2 220          | 3 200         | 6 000           | 9 000 | HMK2620            | —                    | 0.040           | —                                       |
| 28                  | 35 | 16 | —            | 17 300             | 27 600      | 1 760          | 2 820         | 5 500           | 8 500 | HK2816             | —                    | 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 | —                  | BK3016C              | 0.037           | IR25×30×17                              |
|                     | 37 | 20 | —            | 22 300             | 39 500      | 2 280          | 4 000         | 5 500           | 8 000 | HK3020             | —                    | 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 | HK3026             | —                    | 0.053           | IR25×30×26.5                            |
|                     | 37 | 26 | 2.7          | 29 100             | 55 000      | 2 960          | 5 650         | 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-120.)  
EX. HK2820 + IR22×28×20.5





$F_w$  30~40mm

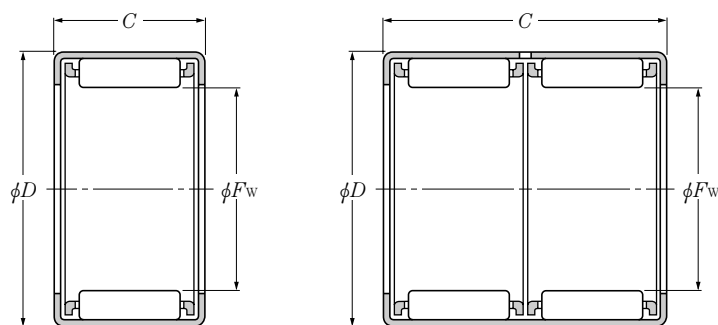
| Boundary dimensions |     |                  |              | Basic load ratings |         |         |        | Limiting speeds |       | Bearing numbers   |               | Mass      | Appropriate <sup>1)</sup><br>inner ring |
|---------------------|-----|------------------|--------------|--------------------|---------|---------|--------|-----------------|-------|-------------------|---------------|-----------|-----------------------------------------|
| mm                  |     |                  |              | dynamic            | static  | dynamic | static | r/min           |       | open end          | closed end    | kg        |                                         |
| $F_w$               | $D$ | $C$<br>0<br>-0.2 | $C_1$<br>max | N                  |         | kgf     |        | grease          | oil   | design            | design        | (approx.) | (as a reference)                        |
| <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               | —            | 19 700             | 35 000  | 2 000   | 3 600  | 4 700           | 7 000 | <b>HK3516</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               | —            | 21 100             | 40 000  | 2 150   | 4 100  | 4 000           | 6 000 | <b>HK4016</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-121, B122.)  
EX. HK4012 + IR35×40×12.5

## Type HK

## Type HMK, Type HMK··ZWD

## Type BK



Type HK, Type HMK

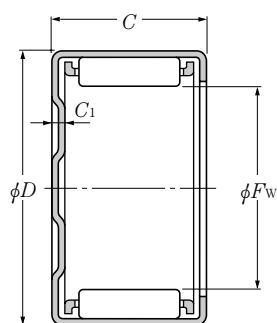
Type HMK··ZWD

Opened End Type

$F_w$  40~50mm

| Boundary dimensions |     |                  |              | Basic load ratings |         |         |        | Limiting speeds |       | Bearing numbers    |                      | Mass            | Appropriate <sup>1)</sup><br>inner ring |
|---------------------|-----|------------------|--------------|--------------------|---------|---------|--------|-----------------|-------|--------------------|----------------------|-----------------|-----------------------------------------|
| mm                  |     |                  |              | dynamic            | static  | dynamic | static | r/min           |       | open end<br>design | closed end<br>design | kg<br>(approx.) | (as a reference)                        |
| $F_w$               | $D$ | $C$<br>0<br>-0.2 | $C_1$<br>max | N                  |         | kgf     |        | grease          | oil   |                    |                      |                 |                                         |
| 40                  | 50  | 30               | —            | 49 000             | 85 000  | 5 000   | 8 700  | 4 000           | 6 000 | HMK4030            | —                    | 0.112           | IR35×40×34                              |
|                     | 50  | 40               | —            | 58 500             | 107 000 | 5 950   | 10 900 | 4 000           | 6 000 | HMK4040ZWD         | —                    | 0.150           | —                                       |
| 45                  | 52  | 16               | —            | 21 600             | 43 000  | 2 210   | 4 400  | 3 700           | 5 500 | HK4516             | —                    | 0.046           | IR40×45×17                              |
|                     | 52  | 16               | 2.7          | 21 600             | 43 000  | 2 210   | 4 400  | 3 700           | 5 500 | —                  | BK4516               | 0.058           | IR40×45×17                              |
|                     | 52  | 20               | —            | 27 600             | 59 000  | 2 810   | 6 000  | 3 700           | 5 500 | HK4520             | —                    | 0.058           | IR40×45×20.5                            |
|                     | 52  | 20               | 2.7          | 27 600             | 59 000  | 2 810   | 6 000  | 3 700           | 5 500 | —                  | BK4520               | 0.072           | IR40×45×20.5                            |
|                     | 55  | 20               | —            | 33 000             | 53 000  | 3 350   | 5 400  | 3 700           | 5 500 | HMK4520            | —                    | 0.083           | IR40×45×20.5                            |
|                     | 55  | 25               | —            | 41 500             | 71 500  | 4 250   | 7 300  | 3 700           | 5 500 | HMK4525            | —                    | 0.104           | IR40×45×26.5                            |
|                     | 55  | 30               | —            | 49 500             | 90 000  | 5 050   | 9 150  | 3 700           | 5 500 | HMK4530            | —                    | 0.125           | IR40×45×34                              |
|                     | 55  | 40               | —            | 59 500             | 113 000 | 6 050   | 11 500 | 3 700           | 5 500 | HMK4540ZWD         | —                    | 0.167           | —                                       |
| 50                  | 58  | 20               | —            | 31 500             | 63 000  | 3 200   | 6 450  | 3 200           | 4 800 | HK5020             | —                    | 0.072           | IR40×50×22                              |
|                     | 58  | 20               | 2.7          | 31 500             | 63 000  | 3 200   | 6 450  | 3 200           | 4 800 | —                  | BK5020               | 0.087           | IR40×50×22                              |
|                     | 58  | 25               | —            | 38 500             | 82 000  | 3 900   | 8 400  | 3 200           | 4 800 | HK5025             | —                    | 0.090           | IR45×50×25.5                            |
|                     | 58  | 25               | 2.7          | 38 500             | 82 000  | 3 900   | 8 400  | 3 200           | 4 800 | —                  | BK5025               | 0.109           | IR45×50×25.5                            |
|                     | 62  | 12               | —            | 18 200             | 23 600  | 1 860   | 2 410  | 3 200           | 4 800 | HMK5012            | —                    | 0.067           | —                                       |
|                     | 62  | 15               | —            | 25 900             | 37 000  | 2 650   | 3 800  | 3 200           | 4 800 | HMK5015            | —                    | 0.084           | —                                       |
|                     | 62  | 20               | —            | 37 500             | 60 000  | 3 850   | 6 100  | 3 200           | 4 800 | HMK5020            | —                    | 0.112           | IR40×50×22                              |
|                     | 62  | 25               | —            | 48 000             | 82 500  | 4 900   | 8 450  | 3 200           | 4 800 | HMK5025            | —                    | 0.140           | IR45×50×25.5                            |
|                     | 62  | 30               | —            | 58 500             | 105 000 | 5 950   | 10 700 | 3 200           | 4 800 | HMK5030B           | —                    | 0.168           | IR45×50×32                              |
|                     | 62  | 40               | —            | 70 000             | 134 000 | 7 150   | 13 600 | 3 200           | 4 800 | HMK5040ZWD         | —                    | 0.224           | —                                       |
|                     | 62  | 45               | —            | 79 000             | 156 000 | 8 050   | 15 900 | 3 200           | 4 800 | HMK5045ZWBD        | —                    | 0.252           | —                                       |

Note 1) Bearing with inner ring is represented by HK+IR. (Refer to "Inner Ring Dimensions Table" on page B-122, B123.)  
EX. HK4516 + IR40×45×17



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

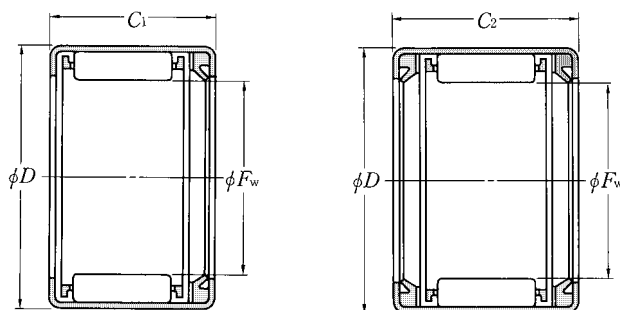
Type HK···L

Type HMK···L

Type HK···LL

Type HMK···LL

Type BK···L



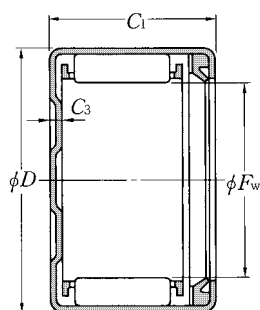
Type HK···L, Type HMK···L  
(Opened end and single-side seal type)

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

$F_w$  8~25mm

| Boundary dimensions |     |                          |                    |              | Basic load ratings    |                         |                         |                           | Limiting speeds<br>r/min<br>grease | Bearing numbers         |                         |                           |
|---------------------|-----|--------------------------|--------------------|--------------|-----------------------|-------------------------|-------------------------|---------------------------|------------------------------------|-------------------------|-------------------------|---------------------------|
| $F_w$               | $D$ | mm<br>$C_1$<br>0<br>-0.2 | $C_2$<br>0<br>-0.2 | $C_3$<br>max | dynamic<br>N<br>$C_r$ | static<br>N<br>$C_{or}$ | dynamic<br>kgf<br>$C_r$ | static<br>kgf<br>$C_{or}$ |                                    | open end<br>single seal | open end<br>double seal | closed end<br>single seal |
| 8                   | 15  | 12                       | 14                 | —            | 3 800                 | 2 870                   | 390                     | 293                       | 10 000                             | HMK0812L                | HMK0814LL               | —                         |
| 10                  | 17  | 12                       | 14                 | —            | 4 250                 | 3 450                   | 435                     | 350                       | 10 000                             | HMK1012L                | HMK1014LL               | —                         |
| 12                  | 18  | 14                       | 16                 | 2.7          | 6 600                 | 7 300                   | 675                     | 745                       | 10 000                             | HK 1214L                | HK 1216LL               | BK1214L                   |
|                     | 19  | 14                       | 16                 | —            | 7 100                 | 6 900                   | 725                     | 705                       | 10 000                             | HMK1214L                | HMK1216LL               | —                         |
| 14                  | 20  | 14                       | 16                 | 2.7          | 7 200                 | 8 500                   | 735                     | 865                       | 10 000                             | HK 1414L                | HK 1416LL               | BK1414L                   |
|                     | 22  | 19                       | 22                 | —            | 11 500                | 12 000                  | 1 180                   | 1 220                     | 10 000                             | HMK1419L                | HMK1422LL               | —                         |
| 15                  | 21  | 14                       | 16                 | 2.7          | 7 500                 | 9 100                   | 765                     | 930                       | 10 000                             | HK 1514L                | HK 1516LL               | BK1514L                   |
|                     | 22  | 13                       | 16                 | —            | 6 100                 | 6 000                   | 620                     | 610                       | 10 000                             | HMK1513L                | HMK1516LL               | —                         |
|                     | 22  | 18                       | 21                 | —            | 10 900                | 12 700                  | 1 120                   | 1 300                     | 10 000                             | HMK1518L                | HMK1521LL               | —                         |
| 16                  | 22  | 14                       | 16                 | 2.7          | 7 750                 | 9 700                   | 795                     | 990                       | 10 000                             | HK 1614L                | HK 1616LL               | BK1614L                   |
|                     | 24  | 23                       | 26                 | —            | 15 600                | 18 200                  | 1 590                   | 1 860                     | 10 000                             | HMK1623L                | HMK1626LL               | —                         |
| 17                  | 24  | 18                       | 21                 | —            | 12 100                | 15 000                  | 1 230                   | 1 530                     | 9 500                              | HMK1718L                | HMK1721LL               | —                         |
| 18                  | 24  | 14                       | 16                 | 2.7          | 8 300                 | 10 900                  | 845                     | 1 110                     | 9 000                              | HK 1814L                | HK 1816LL               | BK1814L                   |
|                     | 25  | 18                       | 21                 | —            | 12 000                | 15 100                  | 1 220                   | 1 540                     | 9 000                              | HMK1818L                | HMK1821LL               | —                         |
|                     | 25  | 20                       | 23                 | —            | 13 800                | 18 000                  | 1 400                   | 1 830                     | 9 000                              | HMK1820L                | HMK1823LL               | —                         |
| 19                  | 27  | 19                       | 22                 | —            | 13 900                | 16 300                  | 1 410                   | 1 660                     | 8 500                              | HMK1919L                | HMK1922LL               | —                         |
| 20                  | 26  | —                        | 16                 | —            | 9 250                 | 13 000                  | 945                     | 1 330                     | 8 000                              | —                       | HK 2016LL               | —                         |
|                     | 26  | 18                       | 20                 | 2.7          | 13 000                | 20 100                  | 1 320                   | 2 050                     | 8 000                              | HK 2018L                | HK 2020LL               | BK2018L                   |
|                     | 27  | 18                       | 21                 | —            | 13 000                | 17 300                  | 1 330                   | 1 760                     | 8 000                              | HMK2018L                | HMK2021LL               | —                         |
|                     | 27  | 23                       | 26                 | —            | 17 700                | 25 600                  | 1 800                   | 2 610                     | 8 000                              | HMK2023L                | HMK2026LL               | —                         |
| 22                  | 28  | —                        | 16                 | —            | 9 750                 | 14 300                  | 995                     | 1 460                     | 7 500                              | —                       | HK 2216LL               | —                         |
|                     | 28  | 18                       | 20                 | 2.7          | 13 600                | 22 100                  | 1 390                   | 2 250                     | 7 500                              | HK 2218L                | HK 2220LL               | BK2218L                   |
|                     | 29  | 18                       | 21                 | —            | 13 400                | 18 500                  | 1 370                   | 1 890                     | 7 500                              | HMK2218L                | HMK2221LL               | —                         |
|                     | 29  | 23                       | 26                 | —            | 18 200                | 27 400                  | 1 860                   | 2 790                     | 7 500                              | HMK2223L                | HMK2226LL               | —                         |
| 24                  | 31  | 23                       | 26                 | —            | 18 800                | 29 100                  | 1 910                   | 2 970                     | 6 500                              | HMK2423L                | HMK2426LL               | —                         |
| 25                  | 32  | —                        | 16                 | —            | 11 800                | 16 300                  | 1 200                   | 1 660                     | 6 500                              | —                       | HK 2516LL               | —                         |
|                     | 32  | 18                       | 20                 | 2.7          | 15 900                | 24 000                  | 1 620                   | 2 450                     | 6 500                              | HK 2518L                | HK 2520LL               | BK2518L                   |

Note 1) Bearing with inner ring is represented by HK+IR. (Refer to "Inner Ring Dimensions Table" on page B-117 to B-119.)  
EX. HK1416LL + IR10×14×20



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

| open end<br>single seal | Mass<br>kg<br>(approx.) |                           | Appropriate <sup>1)</sup><br>inner ring<br>(as a reference) |              |
|-------------------------|-------------------------|---------------------------|-------------------------------------------------------------|--------------|
|                         | open end<br>double seal | closed end<br>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   |

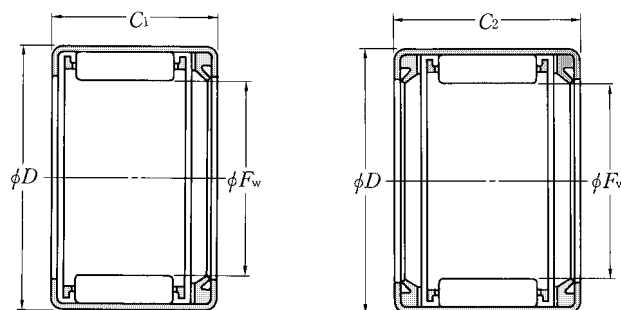
Type HK···L

Type HMK···L

Type HK···LL

Type HMK···LL

Type BK···L



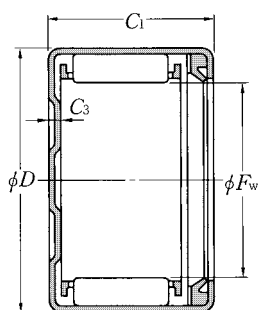
Type HK···L, Type HMK···L  
(Opened end and single-side seal type)

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

$F_w$  25~50mm

| Boundary dimensions |    |                    |                    |              | Basic load ratings |          |         |          | Limiting speeds<br>r/min<br>grease | Bearing numbers         |                         |                           |
|---------------------|----|--------------------|--------------------|--------------|--------------------|----------|---------|----------|------------------------------------|-------------------------|-------------------------|---------------------------|
| $F_w$               | D  | mm                 |                    |              | dynamic            | static   | dynamic | static   |                                    | open end<br>single seal | open end<br>double seal | closed end<br>single seal |
|                     |    | $C_1$<br>0<br>-0.2 | $C_2$<br>0<br>-0.2 | $C_3$<br>max | N                  |          | kgf     |          |                                    |                         |                         |                           |
|                     |    |                    |                    |              | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ |                                    |                         |                         |                           |
| 25                  | 33 | 18                 | 21                 | —            | 15 800             | 21 000   | 1 610   | 2 140    | 6 500                              | HMK2518L                | HMK2521LL               | —                         |
|                     | 33 | 23                 | 26                 | —            | 21 800             | 31 500   | 2 220   | 3 200    | 6 500                              | HMK2523L                | HMK2526LL               | —                         |
| 28                  | 35 | —                  | 20                 | —            | 17 300             | 27 600   | 1 760   | 2 820    | 5 500                              | —                       | HK 2820LL               | —                         |
|                     | 37 | 23                 | 26                 | —            | 23 600             | 32 500   | 2 410   | 3 350    | 5 500                              | HMK2823L                | HMK2826LL               | —                         |
| 30                  | 37 | —                  | 16                 | —            | 13 000             | 19 500   | 1 320   | 1 990    | 5 500                              | —                       | HK 3016LL               | —                         |
|                     | 37 | 18                 | 20                 | 2.7          | 18 100             | 30 000   | 1 850   | 3 050    | 5 500                              | HK 3018L                | HK 3020LL               | BK3018L                   |
|                     | 40 | 23                 | 26                 | —            | 24 200             | 34 500   | 2 470   | 3 500    | 5 500                              | HMK3023L                | HMK3026LL               | —                         |
|                     | 40 | 28                 | 31                 | —            | 31 000             | 47 000   | 3 150   | 4 800    | 5 500                              | HMK3028L                | HMK3031LL               | —                         |
| 32                  | 42 | 23                 | 26                 | —            | 27 500             | 38 000   | 2 800   | 3 850    | 5 000                              | HMK3223L                | HMK3226LL               | —                         |
| 35                  | 42 | —                  | 16                 | —            | 14 000             | 22 800   | 1 430   | 2 320    | 4 600                              | —                       | HK 3516LL               | —                         |
|                     | 42 | 18                 | 20                 | 2.7          | 19 700             | 35 000   | 2 000   | 3 600    | 4 600                              | HK 3518L                | HK 3520LL               | BK3518L                   |
|                     | 45 | 18                 | 21                 | —            | 20 200             | 26 200   | 2 060   | 2 670    | 4 600                              | HMK3518L                | HMK3521LL               | —                         |
|                     | 45 | 28                 | 31                 | —            | 36 000             | 54 500   | 3 650   | 5 550    | 4 600                              | HMK3528L                | HMK3531LL               | —                         |
| 38                  | 48 | 28                 | 31                 | —            | 38 500             | 61 000   | 3 900   | 6 250    | 4 200                              | HMK3828L                | HMK3831LL               | —                         |
| 40                  | 47 | —                  | 16                 | —            | 15 100             | 26 000   | 1 540   | 2 660    | 4 000                              | —                       | HK 4016LL               | —                         |
|                     | 47 | 18                 | 20                 | 2.7          | 21 100             | 40 000   | 2 150   | 4 100    | 4 000                              | HK 4018L                | HK 4020LL               | BK4018L                   |
|                     | 50 | 18                 | 21                 | —            | 23 100             | 32 500   | 2 350   | 3 300    | 4 000                              | HMK4018L                | HMK4021LL               | —                         |
|                     | 50 | 28                 | 31                 | —            | 41 000             | 67 500   | 4 150   | 6 900    | 4 000                              | HMK4028L                | HMK4031LL               | —                         |
| 45                  | 52 | 18                 | 20                 | 2.7          | 21 600             | 43 000   | 2 210   | 4 400    | 3 600                              | HK 4518L                | HK 4520LL               | BK4518L                   |
|                     | 55 | 23                 | 26                 | —            | 33 000             | 53 000   | 3 350   | 5 400    | 3 600                              | HMK4523L                | HMK4526LL               | —                         |
| 50                  | 58 | 22                 | 24                 | 2.7          | 31 500             | 63 000   | 3 200   | 6 450    | 3 200                              | HK 5022L                | HK 5024LL               | BK5022L                   |
|                     | 62 | 28                 | 31                 | —            | 48 000             | 82 500   | 4 900   | 8 450    | 3 200                              | HMK5028L                | HMK5031LL               | —                         |

Note 1) Bearing with inner ring is represented by HK+IR. (Refer to "Inner Ring Dimensions Table" on page B-119 to B123.)  
EX. HK5022L + IR45×50×25



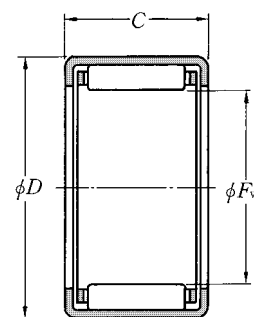
**Type BK·L**  
(Closed end and single-side seal type)

|                         |                         |                           | Appropriate <sup>1)</sup><br>inner ring<br>(as a reference) |              |
|-------------------------|-------------------------|---------------------------|-------------------------------------------------------------|--------------|
|                         | Mass<br>kg<br>(approx.) |                           |                                                             |              |
| open end<br>single seal | open end<br>double seal | closed end<br>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

| Boundary dimensions              |                                  |                          | Basic load ratings |             |                |               | Limiting speeds |              | Bearing numbers | Mass<br>kg<br>(approx.) | Appropriate <sup>1)</sup><br>inner ring<br>(as a reference) |
|----------------------------------|----------------------------------|--------------------------|--------------------|-------------|----------------|---------------|-----------------|--------------|-----------------|-------------------------|-------------------------------------------------------------|
| $F_w$                            | $D$<br>mm ( $\frac{1}{25.4}$ mm) | $C$<br>$\frac{0}{-0.2}$  | dynamic<br>N       | static<br>N | dynamic<br>kgf | static<br>kgf | grease<br>r/min | oil<br>r/min |                 |                         |                                                             |
| <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              | 6 150       | 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-129.)  
EX. DCL96 + MI-060908

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

$F_w$  15.875~25.400mm

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

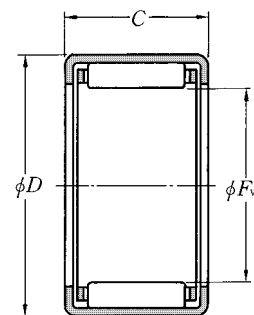
Note 1) Bearing with inner ring is represented by DCL-MI. (Refer to Inner Ring Dimension Table on page B-129.)

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

| Boundary dimensions                        |                                |                                | Basic load ratings |             |                |               | Limiting speeds |              | Bearing numbers | Mass<br>kg<br>(approx.) | Appropriate <sup>1)</sup><br>inner ring<br>(as a reference) |
|--------------------------------------------|--------------------------------|--------------------------------|--------------------|-------------|----------------|---------------|-----------------|--------------|-----------------|-------------------------|-------------------------------------------------------------|
| $F_w$                                      | $D$<br>mm ( $\frac{1}{32}$ mm) | $C$<br>mm ( $\frac{1}{16}$ mm) | dynamic<br>N       | static<br>N | dynamic<br>kgf | static<br>kgf | grease<br>r/min | oil<br>r/min |                 |                         |                                                             |
|                                            |                                |                                | $C_r$              | $C_{or}$    | $C_r$          | $C_{or}$      |                 |              |                 |                         |                                                             |
| <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( $\frac{5}{16}$ )       | 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( $\frac{5}{16}$ )       | 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( $\frac{5}{16}$ )       | 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( $\frac{5}{16}$ )       | 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-130.)  
EX. DCL2414 + MI-202416

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

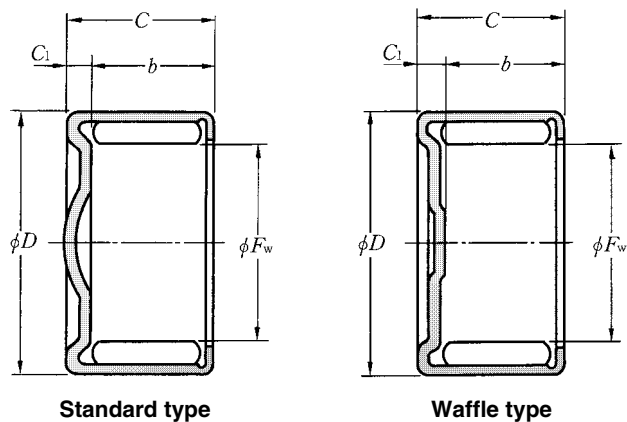
$F_w$  44.450~50.800mm

| Boundary dimensions      |                                  |                          | Basic load ratings    |                    |                         |                    | Limiting speeds |              | Bearing numbers | Mass<br>kg<br>(approx.) | Appropriate <sup>1)</sup><br>inner ring<br>(as a reference) |
|--------------------------|----------------------------------|--------------------------|-----------------------|--------------------|-------------------------|--------------------|-----------------|--------------|-----------------|-------------------------|-------------------------------------------------------------|
| $F_w$                    | $D$<br>mm ( $\frac{1}{25.4}$ mm) | $C$<br>$\frac{0}{-0.2}$  | dynamic<br>N<br>$C_r$ | static<br>$C_{or}$ | dynamic<br>kgf<br>$C_r$ | static<br>$C_{or}$ | grease<br>r/min | oil<br>r/min |                 |                         |                                                             |
| 44.450(1 $\frac{3}{4}$ ) | 53.975(2 $\frac{1}{8}$ )         | 19.050( $\frac{3}{4}$ )  | 29 200                | 47 500             | 2 980                   | 4 850              | 3 700           | 5 500        | DCL2812         | 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        | DCL2816         | 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        | DCL2824         | 0.149                   | —                                                           |
| 47.625(1 $\frac{7}{8}$ ) | 57.150(2 $\frac{1}{4}$ )         | 12.700( $\frac{1}{2}$ )  | 19 700                | 29 200             | 2 000                   | 2 980              | 3 300           | 5 000        | DCL 308         | 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        | DCL3010         | 0.066                   | —                                                           |
|                          | 57.150(2 $\frac{1}{4}$ )         | 25.400(1)                | 42 000                | 78 000             | 4 300                   | 7 950              | 3 300           | 5 000        | DCL3016         | 0.106                   | —                                                           |
| 50.800(2)                | 60.325(2 $\frac{3}{8}$ )         | 12.700( $\frac{1}{2}$ )  | 20 400                | 31 500             | 2 080                   | 3 200              | 3 100           | 4 700        | DCL 328         | 0.056                   | —                                                           |
|                          | 60.325(2 $\frac{3}{8}$ )         | 25.400(1)                | 44 000                | 83 500             | 4 450                   | 8 550              | 3 100           | 4 700        | DCL3216         | 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        | DCL3220         | 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        | DCL3224         | 0.168                   | —                                                           |

Note 1) Bearing with inner ring is represented by DCL-MI. (Refer to Inner Ring Dimension Table on page B-130.)  
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        |
| $F_w$               | $D$  | $C$   | $b$  | $C_1$ | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ |                 |             | (approx.) |
| 10                  | 15   | 9.35  | 7.6  | 1.75  | 6 200              | 9 250    | 635     | 940      | —               | HCK1015     | 0.007     |
| 11.656              | 17.1 | 11.85 | 9.6  | 2.25  | 8 850              | 13 800   | 905     | 1 400    | HCK1217         | —           | 0.011     |
| 13                  | 19   | 11.85 | 9.6  | 2.25  | 10 000             | 15 000   | 1 020   | 1 530    | HCK1319         | —           | 0.013     |
| 14                  | 20   | 11.85 | 9.6  | 2.25  | 10 500             | 16 600   | 1 070   | 1 690    | HCK1420         | —           | 0.014     |
| 16                  | 22   | 12.85 | 10.6 | 2.25  | 12 200             | 20 700   | 1 240   | 2 110    | HCK1622         | —           | 0.017     |
| 18                  | 24   | 13.85 | 11.6 | 2.25  | 13 900             | 25 300   | 1 420   | 2 580    | HCK1824         | —           | 0.021     |
| 18                  | 24.6 | 13.85 | 11.6 | 2.25  | 13 900             | 25 300   | 1 420   | 2 580    | HCK1825         | —           | 0.025     |
| 20                  | 27.9 | 15.82 | 13.1 | 2.72  | 17 800             | 31 000   | 1 810   | 3 150    | HCK2028         | —           | 0.037     |

## Machined Ring Needle Roller Bearings

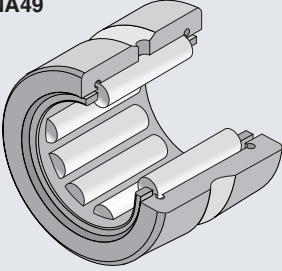
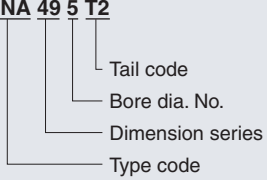
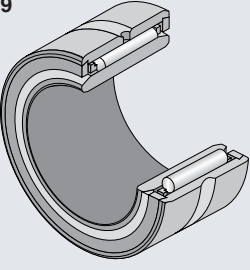
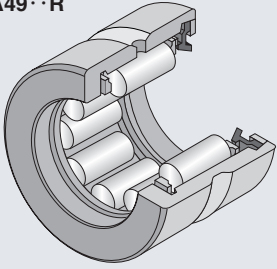
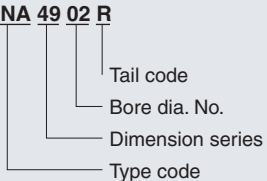
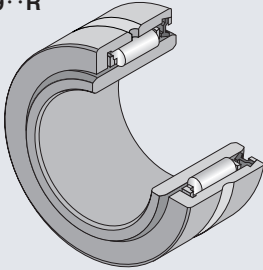


## Machined Ring Needle Roller Bearings

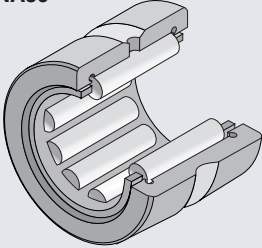
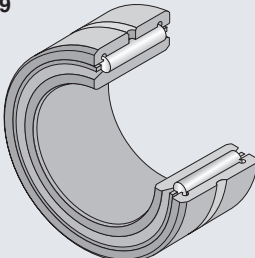
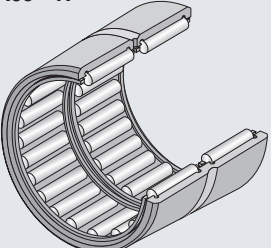
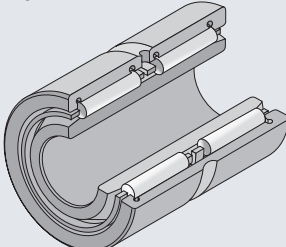
The machined ring of this bearing type contains needle rollers and a cage. And the outer ring and the needle rollers are inseparable from each other by means of double-side ribs on the outer ring or side plates.

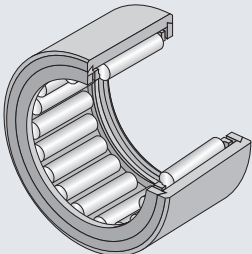
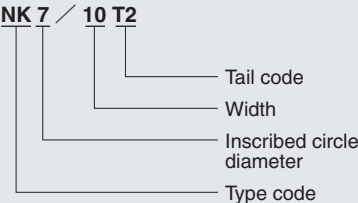
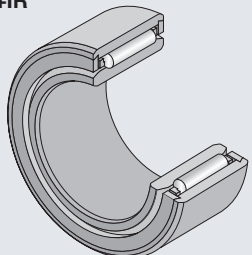
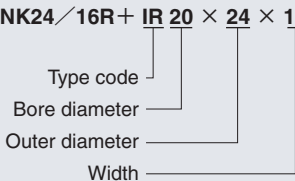
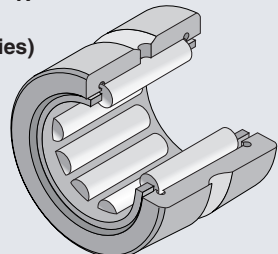
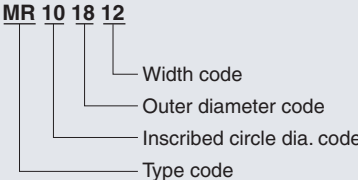
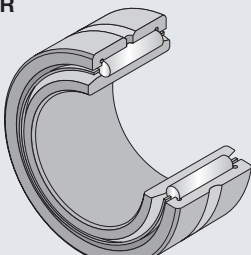
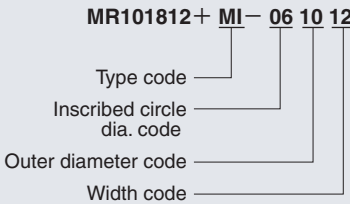
Because of its machined (solid) outer ring enabling to make it more rigid and to thereby upgrade the bearing accuracy, this bearing type is suitable for an application

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                                                                                                 | Applied shaft diameter (mm)                                    | Composition of nominal bearing number                                                                      | Remarks                                                                                                                                                                                                                    |
|--------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Type RNA49</b><br>       | $\phi 7 \sim \phi 12$                                          | <b>RNA 49 5 T2</b><br>   | <p>Bearing with tail code 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>                                             |
| <b>Type NA49</b><br>       | $\phi 5 \sim \phi 9$                                           | <b>[Tail code]</b><br>T2: Resin cage                                                                       | <p>The dimension series is in compliance with JIS B 1512 or ISO 15.</p>                                                                                                                                                    |
| <b>Type RNA49 · R</b><br> | $\phi 14 \sim \phi 490$<br>With seal<br>$\phi 14 \sim \phi 58$ | <b>RNA 49 02 R</b><br> | <p>Bearing with seal type (Tail code: L or LL) - synthetic rubber seal built in at single side or double sides is internally filled up with lithium soap base grease.</p>                                                  |
| <b>Type NA49 · R</b><br>  | $\phi 10 \sim \phi 440$<br>With seal<br>$\phi 10 \sim \phi 50$ | <b>[Tail code]</b><br>R: Rib type<br>L: Single-side seal type<br>LL: Double-side seal type                 | <p>The sealed bearing type shall be used within the temperature range of -25 to 100°C to prevent deterioration of the seal and filled-up grease.</p> <p>The dimension series is in compliance with JIS B 15 or ISO 15.</p> |



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

| Bearing type                                                                                                                                                | Applied shaft diameter (mm)                                                             | Composition of nominal bearing number                                                                                                                                                    | Remarks                                                                                                                                                                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Type NK</b><br>                                                         | $\phi 5 \sim \phi 12$                                                                   | <b>NK 7 / 10 T2</b><br>                                                                                |                                                                                                                                                                         |
| <b>Type NK+IR</b><br>                                                      | $\phi 5 \sim \phi 9$                                                                    | <b>NK24 / 16R + IR 20 × 24 × 16</b><br> <p><b>[Tail code]</b><br/> R: Rib type<br/> T2: Resin cage</p> | Bearing with tail code 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. |
| <b>Type NK · · R</b><br><b>Type MR</b><br><b>(Inch series)</b><br>        | <b>NK</b><br>$\phi 14 \sim \phi 165$<br><br><b>MR</b><br>$\phi 15.875 \sim \phi 234.95$ | <b>MR 10 18 12</b><br>                                                                               |                                                                                                                                                                         |
| <b>NK · · Type R+IR</b><br><b>Type MR+MI</b><br><b>(Inch series)</b><br> | <b>NK · · R+IR</b><br>$\phi 10 \sim \phi 150$                                           | <b>MR101812 + MI - 06 10 12</b><br>                                                                  |                                                                                                                                                                         |

## 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.

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

The dimensional tolerances for the roller inscribed circle diameters ( $F_w$ ) of bearing **type NK**, **RNA** and **MR** conform to ISO Tolerance Range Class-F6. Refer to this ISO Tolerance Class

in selecting shaft diameter and radial clearance.

## Radial clearance and bearing fits

NTN machined ring needle roller bearings (with inner ring) are all manufactured within the radial clearance range specified in **Table 5.1** of Subsection 5.1 "Radial Clearance in Bearings" (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 respective dimensional tolerances for shaft and housing bore sizes on/in which bearing with inner ring is press-fitted are per **Table 6.3** of 6.4 "Recommended Bearing Fits" (page A-34) which specifies them according to load characteristic, load magnitude, and shaft and housing bore sizes. The profile accuracy and

surface roughness of shaft and housing to be applied are as specified in **Table 7.3** of 7.3 "**Shaft and Housing Accuracy**" (page A-39).

A shaft is used as the direct raceway surface for a bearing without inner ring and, in this case, the shaft diameter (raceway diameter) tolerance is per **Table 1** specifying the tolerances according to each running clearance. And K7 tolerance generally in broad use is applied as the dimensional tolerance for the housing bore. Feel free to contact **NTN** for application of housing bore tolerance other than K7.

For the profile accuracy, surface roughness and hardness of a shaft acting as the raceway surface, refer to **Table 7.4** of 7.4 "**Raceway Surface Accuracy**"(page A-39).

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

| Roller inscribed circle dia.<br>$F_w$<br>mm |       | Tolerance range class for shaft |                |                                |
|---------------------------------------------|-------|---------------------------------|----------------|--------------------------------|
| Over                                        | incl. | Smaller than ordinary clearance | Ordinary class | Larger than ordinary clearance |
|                                             | 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                             |

## Dimension of oil hole in outer ring

The outer ring is provided with an oil hole and an oil groove to facilitate oil lubrication to bearing. (but excluding Type NK with roller inscribed circle diameter ( $F_w$ ) of 12mm and less.)

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

**Table 2 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                  |
| 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 the oil hole locates within 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. For the shoulder dimension and corner roundness ( $r_a$ ) of the shaft and the housing are as specified in applicable "Dimensions Table".

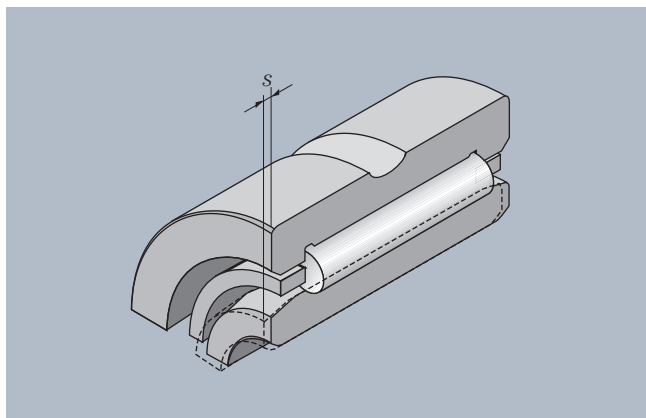


**Fig. 1**

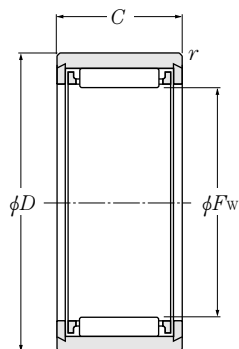
# Without Inner Ring

Type RNA49

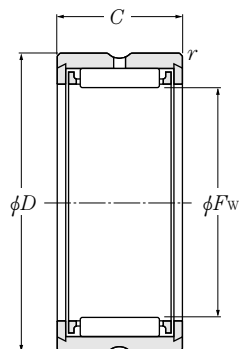
Type RNA59

Type RNA69

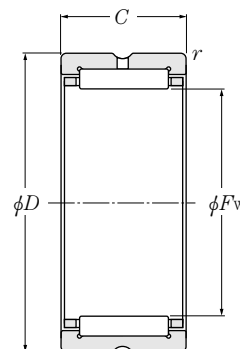
Type NK



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



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

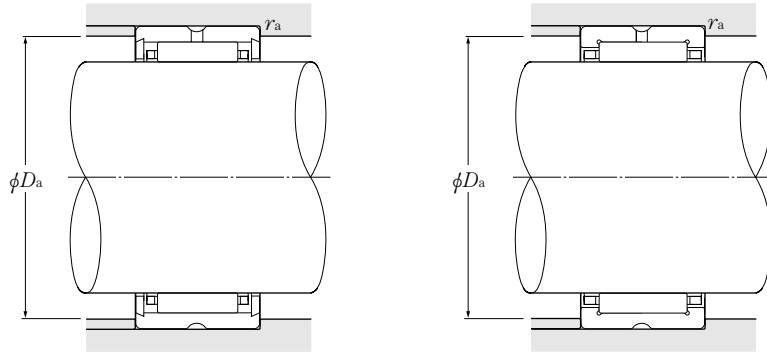


**Type RNA49 · R** ( $F_w \geq 14\text{mm}$ )  
**Type RNA59**  
**Type RNA69 · R**  
**Type NK · R** ( $F_w \geq 14\text{mm}$ )

$F_w$  5~16mm

| Boundary dimensions                    |     |     |                      | Basic load ratings |          |         |          | Limiting speeds |        | Bearing numbers | Abutment dimensions |          | Mass      |
|----------------------------------------|-----|-----|----------------------|--------------------|----------|---------|----------|-----------------|--------|-----------------|---------------------|----------|-----------|
|                                        |     |     |                      | dynamic            | static   | dynamic | static   |                 |        |                 | mm                  |          |           |
| mm                                     |     |     |                      | N                  |          | kgf     |          | grease          | oil    |                 | $D_a$               | $r_{as}$ | kg        |
| $F_w$                                  | $D$ | $C$ | $r_s \text{ min}^1)$ | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ |                 |        |                 | max                 | max      | (approx.) |
| <b>5</b> <sup>+0.018<br/>+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    |
| <b>6</b> <sup>+0.018<br/>+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    |
| <b>7</b> <sup>+0.022<br/>+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    |
| <b>8</b> <sup>+0.022<br/>+0.013</sup>  | 15  | 10  | 0.15                 | 3 150              | 3 000    | 320     | 305      | 21 000          | 32 000 | RNA496          | 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 | NK8/16T2        | 9.5                 | 0.3      | 0.0120    |
| <b>9</b> <sup>+0.022<br/>+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    |
| <b>10</b> <sup>+0.022<br/>+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 | NK10/16         | 11.5                | 0.3      | 0.0130    |
|                                        | 19  | 11  | 0.15                 | 4 300              | 3 950    | 435     | 405      | 19 000          | 28 000 | RNA498          | 12                  | 0.15     | 0.0130    |
| <b>12</b> <sup>+0.027<br/>+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    |
| <b>14</b> <sup>+0.027<br/>+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    |
| <b>15</b> <sup>+0.027<br/>+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    |
| <b>16</b> <sup>+0.027<br/>+0.016</sup> | 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    |

Note 1) Allowable minimum chamfer dimension  $r$ '.



$F_w$  17~28mm

| Boundary dimensions                       |     |     |                         | Basic load ratings |             |                |               | Limiting speeds |        | Bearing numbers | Abutment dimensions |                 | Mass<br>kg<br>(approx.) |
|-------------------------------------------|-----|-----|-------------------------|--------------------|-------------|----------------|---------------|-----------------|--------|-----------------|---------------------|-----------------|-------------------------|
| mm                                        |     |     |                         | dynamic<br>N       | static<br>N | dynamic<br>kgf | static<br>kgf | grease          | oil    |                 | $D_a$<br>max        | $r_{as}$<br>max |                         |
| $F_w$                                     | $D$ | $C$ | $r_s$ min <sup>1)</sup> | $C_r$              | $C_{or}$    | $C_r$          | $C_{or}$      |                 |        |                 |                     |                 |                         |
| 17 <sup>+0.027</sup><br><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><br><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 | NK18/20R        | 24                  | 0.3             | 0.031                   |
| 19 <sup>+0.033</sup><br><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><br><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 | NK20/16R        | 26                  | 0.3             | 0.027                   |
|                                           | 28  | 18  | 0.3                     | 14 100             | 19 100      | 1 440          | 1 950         | 13 000          | 20 000 | RNA5902         | 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                   |
| 21 <sup>+0.033</sup><br><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                     | 18 300             | 27 100      | 1 860          | 2 760         | 13 000          | 19 000 | NK21/20R        | 27                  | 0.3             | 0.035                   |
| 22 <sup>+0.033</sup><br><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                   |
| 24 <sup>+0.033</sup><br><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                   |
| 25 <sup>+0.033</sup><br><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 | NK25/20R        | 31                  | 0.3             | 0.042                   |
|                                           | 37  | 17  | 0.3                     | 21 300             | 25 500      | 2 170          | 2 600         | 11 000          | 16 000 | RNA4904R        | 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                   |
| 26 <sup>+0.033</sup><br><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><br><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 | NK28/30R        | 35                  | 0.3             | 0.082                   |

Note 1) Allowable minimum chamfer dimension  $r_s$ .

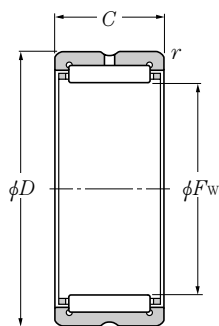
# Without Inner Ring

Type RNA49

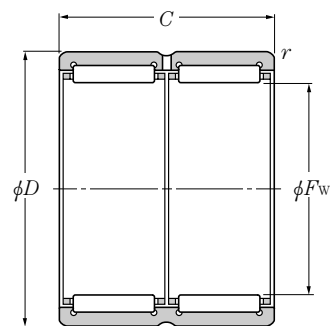
Type RNA59

Type RNA69

Type NK



Type RNA49 · R  
Type RNA59  
Type RNA69 · R ( $F_w \leq 35\text{mm}$ )  
Type NK · R

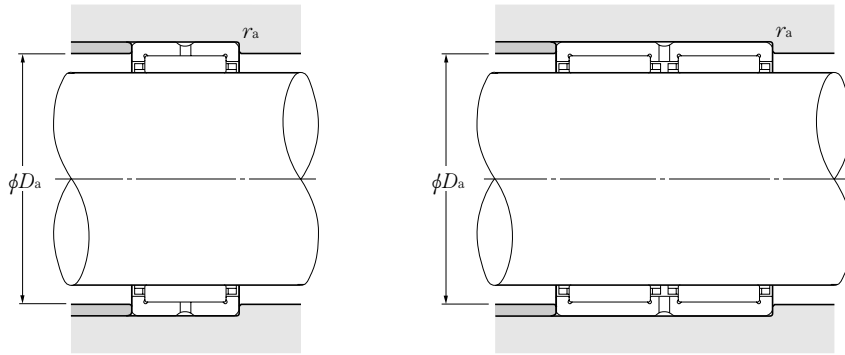


Type RNA69 · Type R ( $F_w \geq 40\text{mm}$ )

$F_w$  28~40mm

| Boundary dimensions             |     |     |                | Basic load ratings |          |         |          | Limiting speeds |        | Bearing numbers | Abutment dimensions |                 | Mass      |
|---------------------------------|-----|-----|----------------|--------------------|----------|---------|----------|-----------------|--------|-----------------|---------------------|-----------------|-----------|
| mm                              |     |     |                | dynamic            | static   | dynamic | static   | r/min           |        |                 | mm                  |                 | kg        |
| $F_w$                           | $D$ | $C$ | $r_s \min ^1)$ | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ | grease          | oil    |                 | $D_a$<br>max        | $r_{as}$<br>max | (approx.) |
| 28 <sup>+0.033<br/>+0.020</sup> | 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     |
| 29 <sup>+0.033<br/>+0.020</sup> | 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<br/>+0.020</sup> | 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     |
| 32 <sup>+0.041<br/>+0.025</sup> | 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 | RNA49/28R       | 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     |
| 35 <sup>+0.041<br/>+0.025</sup> | 45  | 20  | 0.3            | 24 800             | 41 500   | 2 520   | 4 250    | 7 500           | 11 000 | NK35/20R        | 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     |
| 37 <sup>+0.041<br/>+0.025</sup> | 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     |
| 38 <sup>+0.041<br/>+0.025</sup> | 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<br/>+0.025</sup> | 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     |

Note 1) Allowable minimum chamfer dimension  $r$ .



$F_w$  42~63mm

| Boundary dimensions             |     |     |                      | Basic load ratings |          |         |          | Limiting speeds |       | Bearing numbers | Abutment dimensions |          | Mass      |
|---------------------------------|-----|-----|----------------------|--------------------|----------|---------|----------|-----------------|-------|-----------------|---------------------|----------|-----------|
|                                 |     |     |                      | dynamic            | static   | dynamic | static   |                 |       |                 | mm                  |          | kg        |
| mm                              |     |     |                      | N                  |          | kgf     |          | r/min           |       |                 | $D_a$               | $r_{as}$ |           |
| $F_w$                           | $D$ | $C$ | $r_s \text{ min}^1)$ | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ | grease          | oil   |                 | max                 | max      | (approx.) |
| 42 <sup>+0.041<br/>+0.025</sup> | 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<br/>+0.025</sup> | 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     |
| 45 <sup>+0.041<br/>+0.025</sup> | 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 | NK45/30R        | 53                  | 0.3      | 0.139     |
| 47 <sup>+0.041<br/>+0.025</sup> | 57  | 20  | 0.3                  | 28 800             | 55 500   | 2 940   | 5 650    | 5 500           | 8 500 | NK47/20R        | 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<br/>+0.025</sup> | 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<br/>+0.025</sup> | 62  | 25  | 0.6                  | 38 500             | 74 500   | 3 950   | 7 550    | 5 500           | 8 000 | NK50/25R        | 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     |
| 52 <sup>+0.049<br/>+0.030</sup> | 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<br/>+0.030</sup> | 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      | 0.267     |
| 58 <sup>+0.049<br/>+0.030</sup> | 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<br/>+0.030</sup> | 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     |
| 63 <sup>+0.049<br/>+0.030</sup> | 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     |

Note 1) Allowable minimum chamfer dimension  $r_s$ .



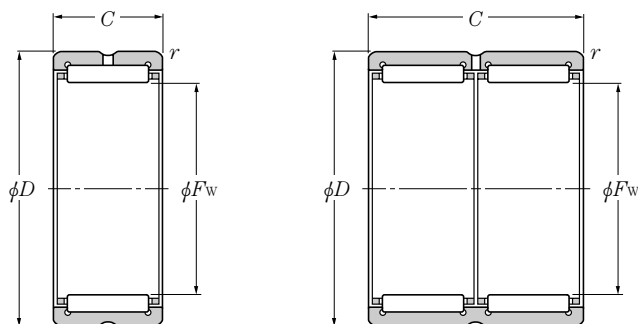
# Without Inner Ring

Type RNA49

Type RNA59

Type RNA69

Type NK



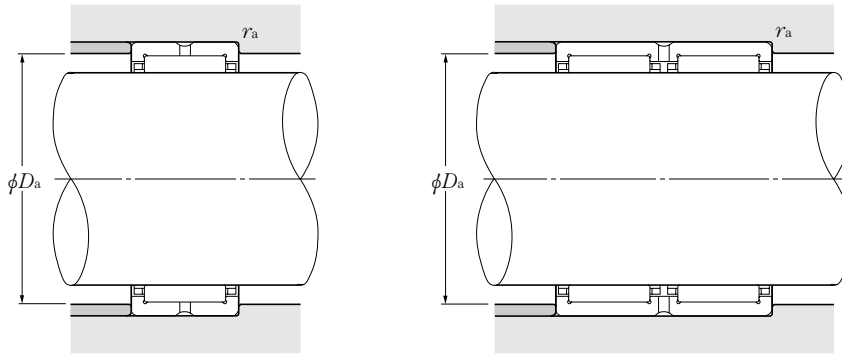
Type RNA48  
Type RNA49··R, Type RNA49  
RNA59 type  
Type NK··R, Type NK

Type RNA69··R

$F_w$  63~85mm

| Boundary dimensions                    |     |     |                | Basic load ratings |          |         |          | Limiting speeds |       | Bearing numbers | Abutment dimensions |          | Mass      |
|----------------------------------------|-----|-----|----------------|--------------------|----------|---------|----------|-----------------|-------|-----------------|---------------------|----------|-----------|
|                                        |     |     |                | dynamic            | static   | dynamic | static   |                 |       |                 | mm                  |          |           |
| mm                                     |     |     |                | N                  |          | kgf     |          | r/min           |       |                 | $D_a$               | $r_{as}$ |           |
| $F_w$                                  | $D$ | $C$ | $r_s \min ^1)$ | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ | grease          | oil   |                 | max                 | max      | (approx.) |
| <b>63</b> <sup>+0.049<br/>+0.030</sup> | 80  | 45  | 1              | 94 000             | 183 000  | 9 600   | 18 600   | 4 300           | 6 500 | <b>RNA6911R</b> | 75                  | 1        | 0.470     |
| <b>65</b> <sup>+0.049<br/>+0.030</sup> | 78  | 25  | 0.6            | 45 000             | 98 000   | 4 550   | 10 000   | 4 000           | 6 000 | <b>NK65/25R</b> | 74                  | 0.6      | 0.221     |
|                                        | 78  | 35  | 0.6            | 60 000             | 142 000  | 6 100   | 14 400   | 4 000           | 6 000 | <b>NK65/35R</b> | 74                  | 0.6      | 0.310     |
| <b>68</b> <sup>+0.049<br/>+0.030</sup> | 82  | 25  | 1              | 44 500             | 89 000   | 4 500   | 9 050    | 4 000           | 6 000 | <b>NK68/25R</b> | 77                  | 0.6      | 0.241     |
|                                        | 82  | 35  | 0.6            | 63 000             | 139 000  | 6 400   | 14 200   | 4 000           | 6 000 | <b>NK68/35R</b> | 78                  | 0.6      | 0.338     |
|                                        | 85  | 25  | 1              | 61 500             | 108 000  | 6 250   | 11 000   | 4 000           | 6 000 | <b>RNA4912R</b> | 80                  | 1        | 0.275     |
|                                        | 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<br/>+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     |
| <b>72</b> <sup>+0.049<br/>+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<br/>+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<br/>+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     |
| <b>80</b> <sup>+0.049<br/>+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 | 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<br/>+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 | 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     |

Note 1) Allowable minimum chamfer dimension  $r$ '.



$F_w$  90~130mm

| Boundary dimensions              |     |       |                  | Basic load ratings |          |         |          | Limiting speeds |       | Bearing numbers | Abutment and fillet dimensions |                 | Mass      |
|----------------------------------|-----|-------|------------------|--------------------|----------|---------|----------|-----------------|-------|-----------------|--------------------------------|-----------------|-----------|
|                                  |     |       |                  | dynamic            | static   | dynamic | static   |                 |       |                 |                                |                 |           |
| mm                               |     |       |                  | N                  |          | kgf     |          | r/min           |       |                 | mm                             |                 | kg        |
| $F_w$                            | $D$ | $B_e$ | $r_{s\min}^{1)}$ | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ | grease          | oil   |                 | $D_a$<br>max                   | $r_{as}$<br>max | (approx.) |
| 90 <sup>+0.058<br/>+0.036</sup>  | 110 | 25    | 1                | 71 500             | 128 000  | 7 300   | 13 100   | 2 900           | 4 400 | NK90/25R        | 105                            | 1               | 0.426     |
|                                  | 110 | 30    | 1                | 90 500             | 174 000  | 9 250   | 17 700   | 2 900           | 4 400 | RNA4916R        | 105                            | 1               | 0.516     |
|                                  | 110 | 35    | 1                | 104 000            | 208 000  | 10 600  | 21 200   | 2 900           | 4 400 | NK90/35R        | 105                            | 1               | 0.604     |
|                                  | 110 | 40    | 1                | 115 000            | 223 000  | 11 700  | 22 700   | 2 900           | 4 400 | RNA5916         | 105                            | 1               | 0.787     |
|                                  | 110 | 54    | 1                | 137 000            | 298 000  | 14 000  | 30 500   | 2 900           | 4 400 | RNA6916R        | 105                            | 1               | 0.987     |
| 95 <sup>+0.058<br/>+0.036</sup>  | 115 | 26    | 1                | 74 500             | 137 000  | 7 600   | 14 000   | 2 800           | 4 200 | NK95/26R        | 110                            | 1               | 0.364     |
|                                  | 115 | 36    | 1                | 108 000            | 223 000  | 11 100  | 22 700   | 2 800           | 4 200 | NK95/36R        | 110                            | 1               | 0.652     |
| 100 <sup>+0.058<br/>+0.036</sup> | 120 | 26    | 1                | 73 500             | 137 000  | 7 500   | 14 000   | 2 700           | 4 000 | NK100/26R       | 115                            | 1               | 0.487     |
|                                  | 120 | 35    | 1.1              | 112 000            | 237 000  | 11 500  | 24 200   | 2 700           | 4 000 | RNA4917R        | 113.5                          | 1               | 0.657     |
|                                  | 120 | 36    | 1                | 107 000            | 223 000  | 11 000  | 22 800   | 2 700           | 4 000 | NK100/36R       | 115                            | 1               | 0.679     |
|                                  | 120 | 46    | 1.1              | 137 000            | 290 000  | 14 000  | 29 600   | 2 700           | 4 000 | RNA5917         | 113.5                          | 1               | 1.00      |
|                                  | 120 | 63    | 1.1              | 169 000            | 400 000  | 17 300  | 41 000   | 2 700           | 4 000 | RNA6917R        | 113.5                          | 1               | 1.20      |
| 105 <sup>+0.058<br/>+0.036</sup> | 125 | 26    | 1                | 76 500             | 147 000  | 7 800   | 14 900   | 2 500           | 3 800 | NK105/26R       | 120                            | 1               | 0.506     |
|                                  | 125 | 35    | 1.1              | 116 000            | 252 000  | 11 900  | 25 700   | 2 500           | 3 800 | RNA4918R        | 118.5                          | 1               | 0.697     |
|                                  | 125 | 36    | 1                | 111 000            | 238 000  | 11 400  | 24 300   | 2 500           | 3 800 | NK105/36R       | 120                            | 1               | 0.713     |
|                                  | 125 | 46    | 1.1              | 143 000            | 310 000  | 14 600  | 32 000   | 2 500           | 3 800 | RNA5918         | 118.5                          | 1               | 1.04      |
|                                  | 125 | 63    | 1.1              | 175 000            | 425 000  | 17 900  | 43 500   | 2 500           | 3 800 | RNA6918R        | 118.5                          | 1               | 1.33      |
| 110 <sup>+0.058<br/>+0.036</sup> | 130 | 30    | 1.1              | 97 500             | 204 000  | 9 950   | 20 800   | 2 400           | 3 600 | NK110/30R       | 123.5                          | 1               | 0.612     |
|                                  | 130 | 35    | 1.1              | 118 000            | 260 000  | 12 000  | 26 500   | 2 400           | 3 600 | RNA4919R        | 123.5                          | 1               | 0.719     |
|                                  | 130 | 40    | 1.1              | 129 000            | 292 000  | 13 100  | 29 700   | 2 400           | 3 600 | NK110/40R       | 123.5                          | 1               | 0.830     |
|                                  | 130 | 46    | 1.1              | 149 000            | 335 000  | 15 200  | 34 000   | 2 400           | 3 600 | RNA5919         | 123.5                          | 1               | 1.13      |
|                                  | 130 | 63    | 1.1              | 177 000            | 440 000  | 18 100  | 45 000   | 2 400           | 3 600 | RNA6919R        | 123.5                          | 1               | 1.46      |
| 115 <sup>+0.058<br/>+0.036</sup> | 140 | 40    | 1.1              | 127 000            | 260 000  | 12 900  | 26 500   | 2 300           | 3 500 | RNA4920         | 133.5                          | 1               | 1.15      |
|                                  | 140 | 54    | 1.1              | 182 000            | 395 000  | 18 600  | 40 500   | 2 300           | 3 500 | RNA5920         | 133.5                          | 1               | 1.76      |
| 120 <sup>+0.058<br/>+0.036</sup> | 140 | 30    | 1                | 93 500             | 210 000  | 9 550   | 21 400   | 2 200           | 3 300 | RNA4822         | 135                            | 1               | 0.670     |
|                                  | 140 | 40    | 1.1              | 113 000            | 268 000  | 11 500  | 27 300   | 2 200           | 3 300 | NK120/40        | 133.5                          | 1               | 0.910     |
| 125 <sup>+0.068<br/>+0.043</sup> | 150 | 40    | 1.1              | 131 000            | 279 000  | 13 300  | 28 400   | 2 100           | 3 200 | RNA4922         | 143.5                          | 1               | 1.24      |
|                                  | 150 | 54    | 1.1              | 193 000            | 440 000  | 19 700  | 45 000   | 2 100           | 3 200 | RNA5922         | 143.5                          | 1               | 1.89      |
| 130 <sup>+0.068<br/>+0.043</sup> | 150 | 30    | 1                | 99 500             | 233 000  | 10 100  | 23 800   | 2 100           | 3 100 | RNA4824         | 145                            | 1               | 0.730     |

Note 1) Allowable minimum chamfer dimension  $r$ .

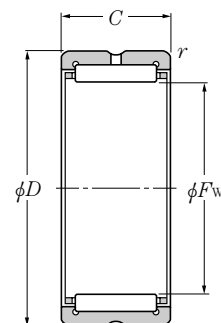
# Without Inner Ring

Type RNA48

Type RNA49

Type RNA59

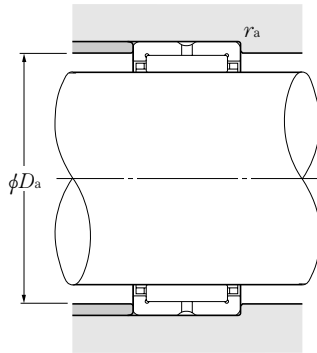
Type NK



$F_w$  130~220mm

| Boundary dimensions     |     |     |                 | Basic load ratings |          |         |          | Limiting speeds |       | Bearing numbers | Abutment dimensions |                 | Mass      |
|-------------------------|-----|-----|-----------------|--------------------|----------|---------|----------|-----------------|-------|-----------------|---------------------|-----------------|-----------|
| mm                      |     |     |                 | dynamic            | static   | dynamic | static   | r/min           |       |                 | mm                  |                 | kg        |
| $F_w$                   | $D$ | $C$ | $r_{s \min}^1)$ | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ | grease          | oil   |                 | $D_a$<br>max        | $r_{as}$<br>max | (approx.) |
| $130^{+0.068}_{+0.043}$ | 150 | 40  | 1.1             | 116 000            | 283 000  | 11 800  | 28 800   | 2 100           | 3 100 | NK130/40        | 143.5               | 1               | 0.98      |
| $135^{+0.068}_{+0.043}$ | 165 | 45  | 1.1             | 180 000            | 380 000  | 18 300  | 38 500   | 2 000           | 3 000 | RNA4924         | 158.5               | 1               | 1.86      |
|                         | 165 | 60  | 1.1             | 245 000            | 525 000  | 25 000  | 53 500   | 2 000           | 3 000 | RNA5924         | 158.5               | 1               | 2.67      |
| $145^{+0.068}_{+0.043}$ | 165 | 35  | 1.1             | 118 000            | 305 000  | 12 100  | 31 000   | 1 900           | 2 800 | RNA4826         | 158.5               | 1               | 0.95      |
|                         | 170 | 32  | 1.5             | 111 000            | 238 000  | 11 300  | 24 300   | 1 900           | 2 800 | NK145/32        | 162.5               | 1.5             | 1.12      |
|                         | 170 | 42  | 1.5             | 153 000            | 360 000  | 15 600  | 36 500   | 1 900           | 2 800 | NK145/42        | 162.5               | 1.5             | 1.49      |
| $150^{+0.068}_{+0.043}$ | 180 | 50  | 1.5             | 202 000            | 455 000  | 20 600  | 46 500   | 1 800           | 2 700 | RNA4926         | 172                 | 1.5             | 2.21      |
|                         | 180 | 67  | 1.5             | 294 000            | 685 000  | 30 000  | 70 000   | 1 800           | 2 700 | RNA5926         | 172                 | 1.5             | 3.21      |
| $155^{+0.068}_{+0.043}$ | 175 | 35  | 1.1             | 121 000            | 315 000  | 12 300  | 32 500   | 1 700           | 2 600 | RNA4828         | 168.5               | 1               | 1.02      |
|                         | 180 | 32  | 1.5             | 114 000            | 252 000  | 11 600  | 25 700   | 1 700           | 2 600 | NK155/32        | 172                 | 1.5             | 1.20      |
|                         | 180 | 42  | 1.5             | 156 000            | 380 000  | 16 000  | 38 500   | 1 700           | 2 600 | NK155/42        | 172                 | 1.5             | 1.59      |
| $160^{+0.068}_{+0.043}$ | 190 | 50  | 1.5             | 209 000            | 485 000  | 21 300  | 49 500   | 1 700           | 2 500 | RNA4928         | 182                 | 1.5             | 2.35      |
|                         | 190 | 67  | 1.5             | 310 000            | 755 000  | 31 500  | 77 000   | 1 700           | 2 500 | RNA5928         | 182                 | 1.5             | 3.48      |
| $165^{+0.068}_{+0.043}$ | 190 | 32  | 1.5             | 117 000            | 265 000  | 11 900  | 27 000   | 1 600           | 2 400 | NK165/32        | 182                 | 1.5             | 1.42      |
|                         | 190 | 40  | 1.1             | 152 000            | 390 000  | 15 500  | 40 000   | 1 600           | 2 400 | RNA4830         | 183.5               | 1               | 1.60      |
|                         | 190 | 42  | 1.5             | 160 000            | 400 000  | 16 300  | 40 500   | 1 600           | 2 400 | NK165/42        | 182                 | 1.5             | 1.66      |
| $170^{+0.068}_{+0.043}$ | 210 | 60  | 2               | 261 000            | 610 000  | 26 600  | 62 500   | 1 600           | 2 400 | RNA4930         | 201                 | 2               | 2.98      |
| $175^{+0.068}_{+0.043}$ | 200 | 40  | 1.1             | 160 000            | 425 000  | 16 300  | 43 500   | 1 500           | 2 300 | RNA4832         | 193.5               | 1               | 1.70      |
| $180^{+0.068}_{+0.043}$ | 220 | 60  | 2               | 270 000            | 650 000  | 27 600  | 66 500   | 1 500           | 2 200 | RNA4932         | 211                 | 2               | 3.10      |
| $185^{+0.079}_{+0.050}$ | 215 | 45  | 1.1             | 185 000            | 495 000  | 18 800  | 50 500   | 1 500           | 2 200 | RNA4834         | 208.5               | 1               | 2.54      |
| $190^{+0.079}_{+0.050}$ | 230 | 60  | 2               | 279 000            | 690 000  | 28 500  | 70 500   | 1 400           | 2 100 | RNA4934         | 221                 | 2               | 3.22      |
| $195^{+0.079}_{+0.050}$ | 225 | 45  | 1.1             | 195 000            | 540 000  | 19 800  | 55 000   | 1 400           | 2 100 | RNA4836         | 218.5               | 1               | 2.68      |
| $205^{+0.079}_{+0.050}$ | 250 | 69  | 2               | 375 000            | 890 000  | 38 500  | 90 500   | 1 300           | 2 000 | RNA4936         | 241                 | 2               | 4.48      |
| $210^{+0.079}_{+0.050}$ | 240 | 50  | 1.5             | 227 000            | 680 000  | 23 200  | 69 000   | 1 300           | 1 900 | RNA4838         | 232                 | 1.5             | 3.21      |
| $215^{+0.079}_{+0.050}$ | 260 | 69  | 2               | 390 000            | 945 000  | 40 000  | 96 500   | 1 300           | 1 900 | RNA4938         | 251                 | 2               | 4.53      |
| $220^{+0.079}_{+0.050}$ | 250 | 50  | 1.5             | 231 000            | 705 000  | 23 600  | 71 500   | 1 200           | 1 800 | RNA4840         | 242                 | 1.5             | 3.35      |

Note 1) Allowable minimum chamfer dimension  $r$ .



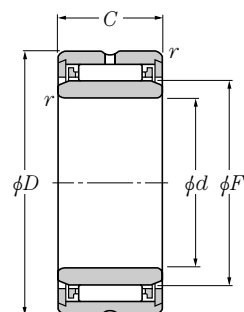
$F_w$  225~490mm

| Boundary dimensions                     |     |       |                   | Basic load ratings |           |         |          | Limiting speeds |       | Bearing numbers | Abutment and fillet dimensions |                 | Mass      |
|-----------------------------------------|-----|-------|-------------------|--------------------|-----------|---------|----------|-----------------|-------|-----------------|--------------------------------|-----------------|-----------|
|                                         |     |       |                   | dynamic            | static    | dynamic | static   |                 |       |                 |                                |                 |           |
| mm                                      |     |       |                   | N                  |           |         |          | r/min           |       | mm              |                                | kg              |           |
| $F_w$                                   | $D$ | $B_e$ | $r_{s \min}^{1)}$ | $C_r$              | $C_{or}$  | $C_r$   | $C_{or}$ | grease          | oil   |                 | $D_a$<br>max                   | $r_{as}$<br>max | (approx.) |
| <b>225</b> <sup>+0.079<br/>+0.050</sup> | 280 | 80    | 2.1               | 505 000            | 1 180 000 | 51 500  | 120 000  | 1 200           | 1 800 | <b>RNA4940</b>  | 269                            | 2               | 7.20      |
| <b>240</b> <sup>+0.079<br/>+0.050</sup> | 270 | 50    | 1.5               | 242 000            | 770 000   | 24 700  | 78 500   | 1 100           | 1 700 | <b>RNA4844</b>  | 262                            | 1.5             | 3.62      |
| <b>245</b> <sup>+0.079<br/>+0.050</sup> | 300 | 80    | 2.1               | 525 000            | 1 270 000 | 53 500  | 129 000  | 1 100           | 1 600 | <b>RNA4944</b>  | 289                            | 2               | 7.81      |
| <b>265</b> <sup>+0.088<br/>+0.056</sup> | 300 | 60    | 2                 | 360 000            | 1 080 000 | 37 000  | 110 000  | 1 000           | 1 500 | <b>RNA4848</b>  | 291                            | 2               | 5.40      |
|                                         | 320 | 80    | 2.1               | 540 000            | 1 350 000 | 55 000  | 138 000  | 1 000           | 1 500 | <b>RNA4948</b>  | 309                            | 2               | 8.40      |
| <b>285</b> <sup>+0.088<br/>+0.056</sup> | 320 | 60    | 2                 | 375 000            | 1 160 000 | 38 000  | 119 000  | 950             | 1 400 | <b>RNA4852</b>  | 311                            | 2               | 5.80      |
| <b>290</b> <sup>+0.088<br/>+0.056</sup> | 360 | 100   | 2.1               | 805 000            | 1 900 000 | 82 000  | 193 000  | 950             | 1 400 | <b>RNA4952</b>  | 349                            | 2               | 15.90     |
| <b>305</b> <sup>+0.088<br/>+0.056</sup> | 350 | 69    | 2                 | 455 000            | 1 300 000 | 46 500  | 133 000  | 850             | 1 300 | <b>RNA4856</b>  | 341                            | 2               | 9.30      |
| <b>310</b> <sup>+0.088<br/>+0.056</sup> | 380 | 100   | 2.1               | 835 000            | 2 030 000 | 85 000  | 207 000  | 850             | 1 300 | <b>RNA4956</b>  | 369                            | 2               | 16.70     |
| <b>330</b> <sup>+0.098<br/>+0.062</sup> | 380 | 80    | 2.1               | 625 000            | 1 770 000 | 64 000  | 180 000  | 800             | 1 200 | <b>RNA4860</b>  | 369                            | 2               | 12.70     |
| <b>340</b> <sup>+0.098<br/>+0.062</sup> | 420 | 118   | 3                 | 1 080 000          | 2 640 000 | 110 000 | 269 000  | 800             | 1 200 | <b>RNA4960</b>  | 407                            | 2.5             | 24.00     |
| <b>350</b> <sup>+0.098<br/>+0.062</sup> | 400 | 80    | 2.1               | 640 000            | 1 850 000 | 65 500  | 189 000  | 750             | 1 100 | <b>RNA4864</b>  | 389                            | 2               | 13.40     |
| <b>360</b> <sup>+0.098<br/>+0.062</sup> | 440 | 118   | 3                 | 1 120 000          | 2 820 000 | 114 000 | 288 000  | 750             | 1 100 | <b>RNA4964</b>  | 427                            | 2.5             | 25.20     |
| <b>370</b> <sup>+0.098<br/>+0.062</sup> | 420 | 80    | 2.1               | 655 000            | 1 940 000 | 66 500  | 197 000  | 750             | 1 100 | <b>RNA4868</b>  | 409                            | 2               | 14.00     |
| <b>380</b> <sup>+0.098<br/>+0.062</sup> | 460 | 118   | 3                 | 1 160 000          | 3 000 000 | 118 000 | 305 000  | 750             | 1 100 | <b>RNA4968</b>  | 447                            | 2.5             | 26.50     |
| <b>390</b> <sup>+0.098<br/>+0.062</sup> | 440 | 80    | 2.1               | 665 000            | 2 020 000 | 68 000  | 206 000  | 650             | 1 000 | <b>RNA4872</b>  | 429                            | 2               | 14.80     |
| <b>400</b> <sup>+0.108<br/>+0.068</sup> | 480 | 118   | 3                 | 1 200 000          | 3 200 000 | 122 000 | 325 000  | 650             | 1 000 | <b>RNA4972</b>  | 467                            | 2.5             | 28.20     |
| <b>415</b> <sup>+0.108<br/>+0.068</sup> | 480 | 100   | 2.1               | 1 000 000          | 2 840 000 | 102 000 | 289 000  | 650             | 950   | <b>RNA4876</b>  | 469                            | 2               | 26.00     |
| <b>430</b> <sup>+0.108<br/>+0.068</sup> | 520 | 140   | 4                 | 1 400 000          | 3 750 000 | 143 000 | 385 000  | 650             | 950   | <b>RNA4976</b>  | 504                            | 3               | 38.60     |
| <b>450</b> <sup>+0.108<br/>+0.068</sup> | 540 | 140   | 4                 | 1 450 000          | 4 000 000 | 148 000 | 410 000  | 600             | 900   | <b>RNA4980</b>  | 524                            | 3               | 40.10     |
| <b>470</b> <sup>+0.108<br/>+0.068</sup> | 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<br/>+0.068</sup> | 600 | 160   | 4                 | 1 750 000          | 4 600 000 | 179 000 | 470 000  | 550             | 800   | <b>RNA4988</b>  | 584                            | 3               | 66.90     |
|                                         |     |       |                   |                    |           |         |          |                 |       |                 |                                |                 |           |

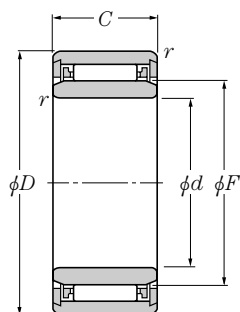
Note 1) Allowable minimum chamfer dimension  $r'$ .

# With inner ring

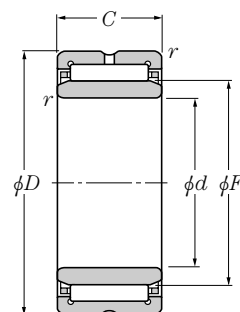
Type NA49  
Type NA59  
Type NA69  
Type NK+IR



Type NA49 ( $d \leq 9\text{mm}$ )



Type NK+IR ( $d \leq 9\text{mm}$ )

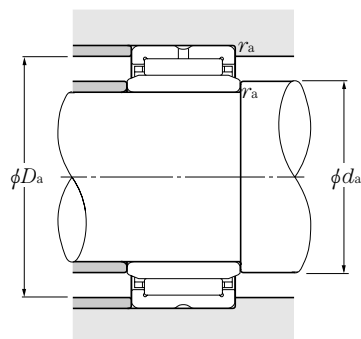
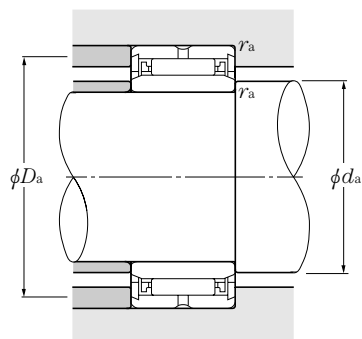
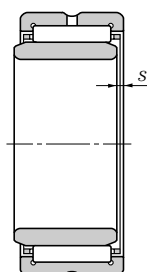


Type NA49·R ( $d \geq 10\text{mm}$ )  
Type NA59  
Type NA69·R  
Type NK+IR ( $d \geq 10\text{mm}$ )

$d$  5~17mm

| Boundary dimensions |          |          |                                         |          |                        | Basic load ratings    |                        |                       |                        | Limiting speeds |        | Bearing numbers     |
|---------------------|----------|----------|-----------------------------------------|----------|------------------------|-----------------------|------------------------|-----------------------|------------------------|-----------------|--------|---------------------|
| mm                  |          |          |                                         |          |                        | dynamic               | static                 | dynamic               | static                 | r/min           |        |                     |
|                     |          |          |                                         |          |                        | N                     |                        | kgf                   |                        | grease          | oil    |                     |
| <i>d</i>            | <i>D</i> | <i>C</i> | <i>r</i> <sub>s min</sub> <sup>1)</sup> | <i>F</i> | <i>s</i> <sup>2)</sup> | <i>C</i> <sub>r</sub> | <i>C</i> <sub>or</sub> | <i>C</i> <sub>r</sub> | <i>C</i> <sub>or</sub> |                 |        |                     |
| 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 | NA496               |
|                     | 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   |
| 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 | NK10/16+IR7×10×16   |
| 8                   | 19       | 11       | 0.15                                    | 10       | —                      | 4 300                 | 3 950                  | 435                   | 405                    | 19 000          | 28 000 | NA498               |
| 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               |
| 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 |
| 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             |
| 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             |
|                     | 28       | 18       | 0.3                                     | 20       | 0.5                    | 14 100                | 19 100                 | 1 440                 | 1 950                  | 13 000          | 20 000 | NA5902              |
|                     | 28       | 23       | 0.3                                     | 20       | 1                      | 17 600                | 25 300                 | 1 790                 | 2 580                  | 13 000          | 20 000 | NA6902R             |
| 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                    | 18 300                | 27 100                 | 1 860                 | 2 760                  | 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              |

Note 1) Allowable minimum chamfer dimension.  $r$ : 2) Allowable axial stroking value of inner ring against outer ring.  
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  | $r_{as}$ max | (approx.) |
| 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     |
| 9                   | 10.5 | 0.15         | 0.010     |
| 9                   | 11.5 | 0.3          | 0.014     |
| 9                   | 11.5 | 0.3          | 0.018     |
| 10                  | 12   | 0.15         | 0.016     |
| 11                  | 13.5 | 0.3          | 0.018     |
| 11                  | 13.5 | 0.3          | 0.022     |
| 11                  | 14   | 0.3          | 0.017     |
| 12                  | 20   | 0.3          | 0.024     |
| 12                  | 20   | 0.3          | 0.030     |
| 12                  | 20   | 0.3          | 0.038     |
| 14                  | 22   | 0.3          | 0.026     |
| 14                  | 22   | 0.3          | 0.033     |
| 14                  | 22   | 0.3          | 0.042     |
| 14                  | 22   | 0.3          | 0.046     |
| 17                  | 25   | 0.3          | 0.039     |
| 17                  | 25   | 0.3          | 0.045     |
| 17                  | 26   | 0.3          | 0.036     |
| 17                  | 26   | 0.3          | 0.052     |
| 17                  | 26   | 0.3          | 0.064     |
| 19                  | 27   | 0.3          | 0.042     |
| 19                  | 27   | 0.3          | 0.053     |
| 19                  | 28   | 0.3          | 0.037     |
| 19                  | 28   | 0.3          | 0.056     |

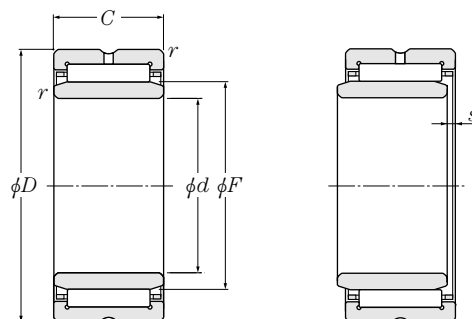
# With inner ring

Type NA49

Type NA59

Type NA69

Type NK+IR



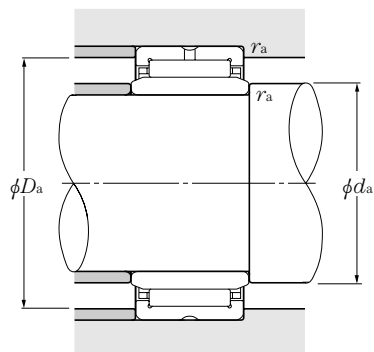
Type NA49 · R  
Type NA59  
Type NA69 · R ( $d \leq 30\text{mm}$ )  
Type NK+IR

$d$  17~32mm

| Boundary dimensions |          |          |                               |          |                        | Basic load ratings    |                        |                       |                        | Limiting speeds |        | Bearing numbers     |
|---------------------|----------|----------|-------------------------------|----------|------------------------|-----------------------|------------------------|-----------------------|------------------------|-----------------|--------|---------------------|
| mm                  |          |          |                               |          |                        | dynamic               | static                 | dynamic               | static                 | r/min           |        |                     |
| <i>d</i>            | <i>D</i> | <i>C</i> | <i>r</i> 's min <sup>1)</sup> | <i>F</i> | <i>s</i> <sup>2)</sup> | N                     |                        | kgf                   |                        | grease          | oil    |                     |
|                     |          |          |                               |          |                        | <i>C</i> <sub>r</sub> | <i>C</i> <sub>or</sub> | <i>C</i> <sub>r</sub> | <i>C</i> <sub>or</sub> |                 |        |                     |
| 17                  | 30       | 23       | 0.3                           | 22       | 1                      | 18 200                | 27 200                 | 1 850                 | 2 770                  | 12 000          | 18 000 | NA6903R             |
| 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 | NA4904R             |
|                     | 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             |
| 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             |
| 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 | NA49/28R            |
|                     | 45       | 23       | 0.3                           | 32       | 0.8                    | 32 000                | 45 500                 | 3 250                 | 4 650                  | 8 500           | 13 000 | NA59/28             |
|                     | 45       | 30       | 0.3                           | 32       | 1                      | 43 000                | 67 000                 | 4 350                 | 6 850                  | 8 500           | 13 000 | NA69/28R            |
| 30                  | 45       | 20       | 0.3                           | 35       | 0.5                    | 24 800                | 41 500                 | 2 520                 | 4 250                  | 7 500           | 11 000 | NK35/20R+IR30×35×20 |
|                     | 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             |
| 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            |

Note 1) Allowable minimum chamfer dimension.  $r$ : 2) Allowable axial stroking value of inner ring against outer ring.  
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 | $r_{as}$ max | (approx.) |
| 19                  | 28  | 0.3          | 0.069     |
| 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                  | 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     |
| 30                  | 40  | 0.3          | 0.096     |
| 30                  | 40  | 0.3          | 0.146     |
| 30                  | 43  | 0.3          | 0.098     |
| 30                  | 43  | 0.3          | 0.142     |
| 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                  | 45  | 0.3          | 0.117     |
| 34                  | 45  | 0.3          | 0.170     |
| 36                  | 48  | 0.6          | 0.157     |

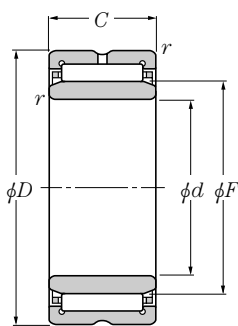
# With inner ring

Type NA49

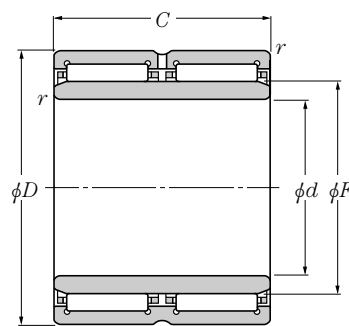
Type NA59

Type NA69

Type NK+IR



Type NA49 · R  
Type NA59  
Type NK · R+IR

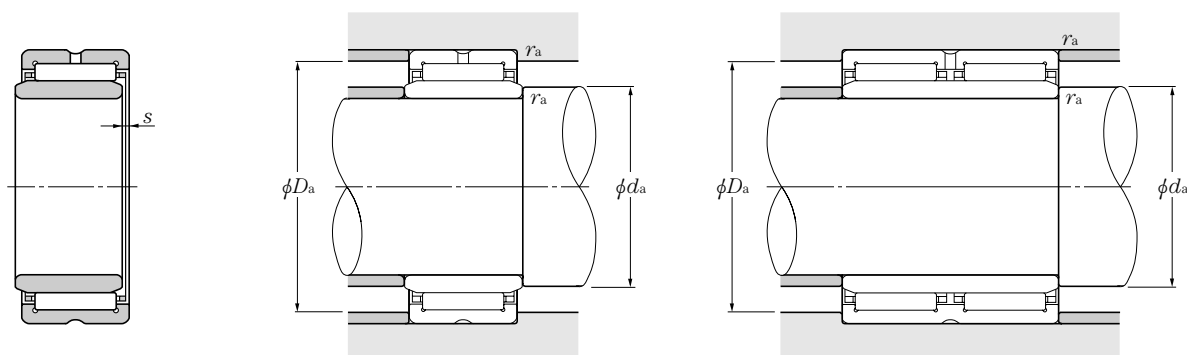


Type NA69 · R

d 32~55mm

| Boundary dimensions |    |    |                                  |    |                 | Basic load ratings |                 |                |                 | Limiting speeds |        | Bearing numbers     |
|---------------------|----|----|----------------------------------|----|-----------------|--------------------|-----------------|----------------|-----------------|-----------------|--------|---------------------|
|                     |    |    |                                  |    |                 | dynamic            | static          | dynamic        | static          |                 |        |                     |
| mm                  |    |    |                                  |    |                 | N                  |                 | kgf            |                 | r/min           |        |                     |
| d                   | D  | C  | r <sub>s min</sub> <sup>1)</sup> | F  | s <sup>2)</sup> | C <sub>r</sub>     | C <sub>or</sub> | C <sub>r</sub> | C <sub>or</sub> | grease          | oil    |                     |
| 32                  | 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          | 4 350           | 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             |
| 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  | NA4908R             |
|                     | 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             |
| 42                  | 57 | 20 | 0.3                              | 47 | 0.5             | 28 800             | 55 500          | 2 940          | 5 650           | 5 500           | 8 500  | NK47/20R+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  | NK50/25R+IR45×50×25 |
|                     | 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             |
| 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                  | 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             |

Note 1) Allowable minimum chamfer dimension. 2) Allowable axial stroking value of inner ring against outer ring.  
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 | $r_{as}$ max | (approx.) |
| 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     |
| 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     |
| 44                  | 55  | 0.3          | 0.148     |
| 44                  | 55  | 0.3          | 0.222     |
| 48                  | 58  | 0.6          | 0.229     |
| 48                  | 58  | 0.6          | 0.322     |
| 49                  | 64  | 0.6          | 0.270     |
| 49                  | 64  | 0.6          | 0.396     |
| 49                  | 64  | 0.6          | 0.437     |
| 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     |
| 58                  | 68  | 0.6          | 0.271     |
| 58                  | 68  | 0.6          | 0.379     |
| 60                  | 75  | 1            | 0.396     |

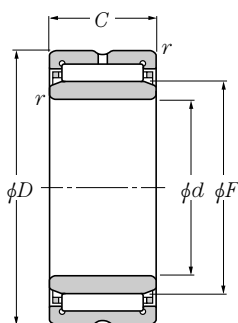
# With inner ring

Type NA49

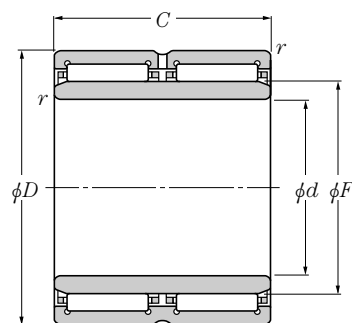
Type NA59

Type NA69

Type NK+IR



Type NA49 · · R  
Type NA59  
Type NK · · R + IR

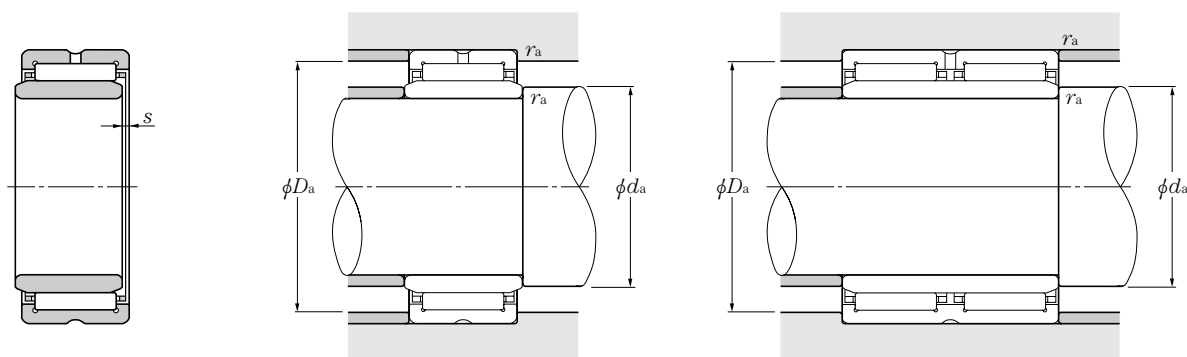


Type NA69 · · R

d 55~85mm

| Boundary dimensions |          |          |                               |          |                        | Basic load ratings    |                        |                       |                        | Limiting speeds |       | Bearing numbers           |
|---------------------|----------|----------|-------------------------------|----------|------------------------|-----------------------|------------------------|-----------------------|------------------------|-----------------|-------|---------------------------|
| mm                  |          |          |                               |          |                        | dynamic               | static                 | dynamic               | static                 | r/min           |       |                           |
|                     |          |          |                               |          |                        | N                     |                        | kgf                   |                        | grease          | oil   |                           |
| <i>d</i>            | <i>D</i> | <i>C</i> | <i>r</i> 's min <sup>1)</sup> | <i>F</i> | <i>s</i> <sup>2)</sup> | <i>C</i> <sub>r</sub> | <i>C</i> <sub>or</sub> | <i>C</i> <sub>r</sub> | <i>C</i> <sub>or</sub> |                 |       |                           |
| 55                  | 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                  | 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       | 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                    | 57 000                | 119 000                | 5 800                 | 12 200                 | 3 300           | 5 000 | NK80/25R + IR70 × 80 × 25 |
|                     | 95       | 35       | 1                             | 80       | 0.8                    | 79 500                | 184 000                | 8 150                 | 18 700                 | 3 300           | 5 000 | NK80/35R + IR70 × 80 × 35 |
|                     | 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      | 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                    | 137 000               | 298 000                | 14 000                | 30 500                 | 2 900           | 4 400 | NA6916R                   |
| 85                  | 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 |

Note 1) Allowable minimum chamfer dimension. 2) Allowable axial stroking value of inner ring against outer ring.  
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 | $r_{as}$ max | (approx.) |
| 60                  | 75  | 1            | 0.559     |
| 60                  | 75  | 1            | 0.726     |
| 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     |
| 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     |
| 75                  | 90  | 1            | 0.525     |
| 75                  | 90  | 1            | 0.738     |
| 75                  | 95  | 1            | 0.727     |
| 75                  | 95  | 1            | 1.06      |
| 75                  | 95  | 1            | 1.34      |
| 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      |
| 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      |
| 90                  | 110 | 1            | 0.644     |
| 90                  | 110 | 1            | 1.05      |

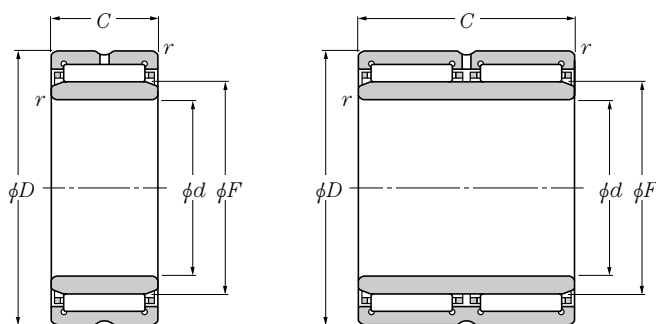
# With inner ring

Type NA48

Type NA49

Type NA59

Type NK+IR



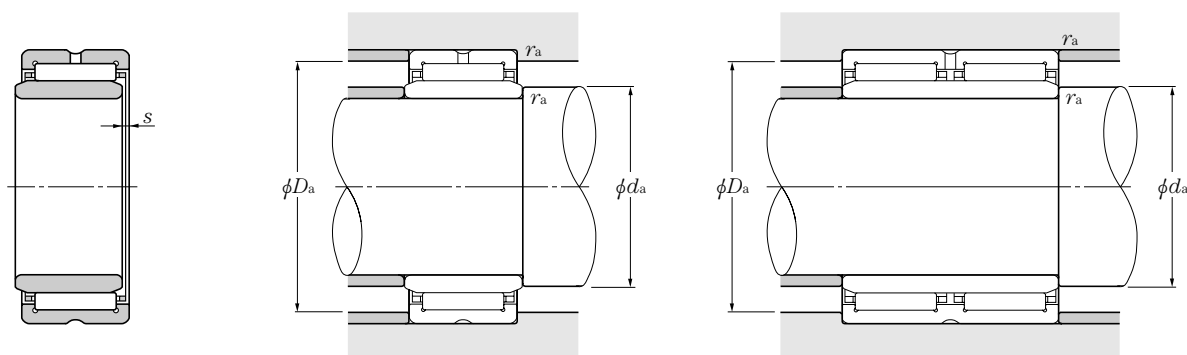
Type NA49·R, Type NA49  
Type NA59  
Type NK·R+IR, Type NK+IR

Type NA69·R

d 85~130mm

| Boundary dimensions |          |          |                               |          |                        | Basic load ratings    |                        |                       |                        | Limiting speeds |       | Bearing numbers        |
|---------------------|----------|----------|-------------------------------|----------|------------------------|-----------------------|------------------------|-----------------------|------------------------|-----------------|-------|------------------------|
| mm                  |          |          |                               |          |                        | dynamic               | static                 | dynamic               | static                 | r/min           |       |                        |
| <i>d</i>            | <i>D</i> | <i>C</i> | <i>r</i> 's min <sup>1)</sup> | <i>F</i> | <i>s</i> <sup>2)</sup> | N                     |                        | kgf                   |                        | grease          | oil   |                        |
|                     |          |          |                               |          |                        | <i>C</i> <sub>r</sub> | <i>C</i> <sub>or</sub> | <i>C</i> <sub>r</sub> | <i>C</i> <sub>or</sub> |                 |       |                        |
| 85                  | 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                 |
|                     | 120      | 63       | 1.1                           | 100      | 1                      | 169 000               | 400 000                | 17 300                | 41 000                 | 2 700           | 4 000 | NA6917R                |
| 90                  | 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      | 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                 |
|                     | 125      | 63       | 1.1                           | 105      | 1                      | 175 000               | 425 000                | 17 900                | 43 500                 | 2 500           | 3 800 | NA6918R                |
| 95                  | 125      | 26       | 1                             | 105      | 1.5                    | 76 500                | 147 000                | 7 800                 | 14 900                 | 2 500           | 3 800 | NK105/26R+IR95×105×26  |
|                     | 125      | 36       | 1                             | 105      | 1.5                    | 111 000               | 238 000                | 11 400                | 24 300                 | 2 500           | 3 800 | NK105/36R+IR95×105×36  |
|                     | 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 |
|                     | 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  |
|                     | 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                      | 245 000               | 525 000                | 25 000                | 53 500                 | 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                 |

Note 1) Allowable minimum chamfer dimension. 2) Allowable axial stroking value of inner ring against outer ring.  
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   | $r_{as}$ max | (approx.) |
| 91.5                | 113.5 | 1            | 1.24      |
| 91.5                | 113.5 | 1            | 1.76      |
| 91.5                | 113.5 | 1            | 2.25      |
| 95                  | 115   | 1            | 0.781     |
| 95                  | 115   | 1            | 1.09      |
| 96.5                | 118.5 | 1            | 1.31      |
| 96.5                | 118.5 | 1            | 1.84      |
| 96.5                | 118.5 | 1            | 2.44      |
| 100                 | 120   | 1            | 0.819     |
| 100                 | 120   | 1            | 1.15      |
| 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               | 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      |
| 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      |



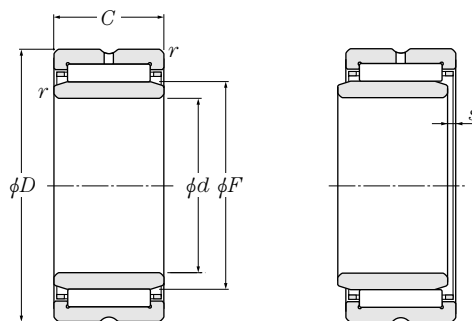
# With inner ring

Type NA48

Type NA49

Type NA59

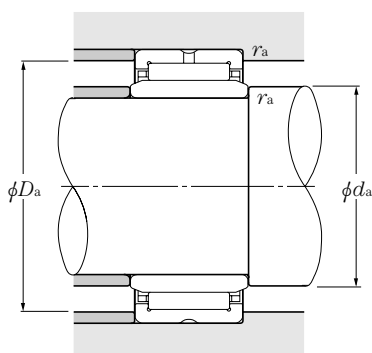
Type NK+IR



d 130~280mm

| Boundary dimensions |     |     |                                  |     |                 | Basic load ratings |                 |                |                 | Limiting speeds |       | Bearing numbers       |
|---------------------|-----|-----|----------------------------------|-----|-----------------|--------------------|-----------------|----------------|-----------------|-----------------|-------|-----------------------|
|                     |     |     |                                  |     |                 | dynamic            | static          | dynamic        | static          |                 |       |                       |
| mm                  |     |     |                                  |     |                 | N                  |                 | kgf            |                 | r/min           |       |                       |
| d                   | D   | C   | r <sub>s min</sub> <sup>1)</sup> | F   | s <sup>2)</sup> | C <sub>r</sub>     | C <sub>or</sub> | C <sub>r</sub> | C <sub>or</sub> | grease          | oil   |                       |
| 130                 | 180 | 67  | 1.5                              | 150 | 1.5             | 294 000            | 685 000         | 30 000         | 70 000          | 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 | 67  | 1.5                              | 160 | 1.5             | 310 000            | 755 000         | 31 500         | 77 000          | 1 700           | 2 500 | NA5928                |
| 150                 | 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                |
|                     | 190 | 42  | 1.5                              | 165 | —               | 160 000            | 400 000         | 16 300         | 40 500          | 1 600           | 2 400 | NK165/42+IR150×165×42 |
|                     | 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                |

Note 1) Allowable minimum chamfer dimension. 2) Allowable axial stroking value of inner ring against outer ring.  
Remarks: Nominal code number of inner ring (IR) comprises the codes of IR bore diameter×outer diameter×width.

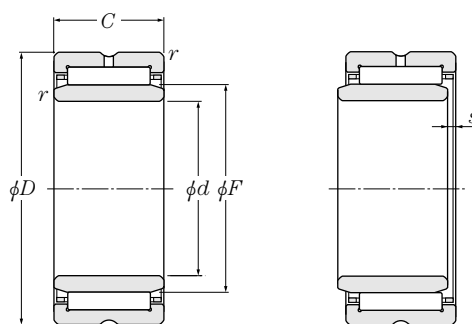


| Abutment dimensions |       |              | Mass      |
|---------------------|-------|--------------|-----------|
| $d_a$               | mm    |              | kg        |
| min                 | max   | $r_{as}$ max | (approx.) |
| 138                 | 172   | 1.5          | 5.60      |
| 146.5               | 168.5 | 1            | 1.82      |
| 148                 | 172   | 1.5          | 2.04      |
| 148                 | 172   | 1.5          | 2.69      |
| 148                 | 182   | 1.5          | 4.05      |
| 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                 | 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      |

# With inner ring

Type NA48

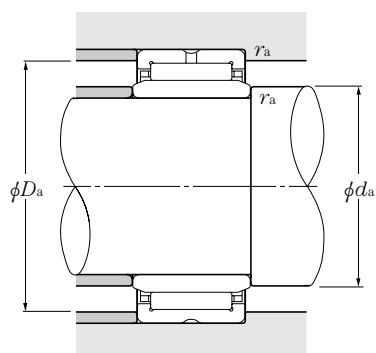
Type NA49



d 300~440mm

| Boundary dimensions |          |          |                                         |          |                        | Basic load ratings    |                        |                       |                        | Limiting speeds |       | Bearing numbers |
|---------------------|----------|----------|-----------------------------------------|----------|------------------------|-----------------------|------------------------|-----------------------|------------------------|-----------------|-------|-----------------|
|                     |          |          |                                         |          |                        | dynamic               | static                 | dynamic               | static                 |                 |       |                 |
| mm                  |          |          |                                         |          |                        | N                     |                        | kgf                   |                        | r/min           |       |                 |
| <i>d</i>            | <i>D</i> | <i>C</i> | <i>r</i> <sub>s min</sub> <sup>1)</sup> | <i>F</i> | <i>s</i> <sup>2)</sup> | <i>C</i> <sub>r</sub> | <i>C</i> <sub>or</sub> | <i>C</i> <sub>r</sub> | <i>C</i> <sub>or</sub> | grease          | oil   |                 |
| 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          |
| 340                 | 420      | 80       | 2.1                                     | 370      | 2                      | 655 000               | 1 940 000              | 66 500                | 197 000                | 750             | 1 100 | NA4868          |
|                     | 460      | 118      | 3                                       | 380      | 2                      | 1 160 000             | 3 000 000              | 118 000               | 305 000                | 750             | 1 100 | NA4968          |
| 360                 | 440      | 80       | 2.1                                     | 390      | 2                      | 665 000               | 2 020 000              | 68 000                | 206 000                | 650             | 1 000 | NA4872          |
|                     | 480      | 118      | 3                                       | 400      | 2                      | 1 200 000             | 3 200 000              | 122 000               | 325 000                | 650             | 1 000 | NA4972          |
| 380                 | 480      | 100      | 2.1                                     | 415      | 2                      | 1 000 000             | 2 840 000              | 102 000               | 289 000                | 650             | 950   | NA4876          |
|                     | 520      | 140      | 4                                       | 430      | 2                      | 1 400 000             | 3 750 000              | 143 000               | 385 000                | 650             | 950   | NA4976          |
| 400                 | 540      | 140      | 4                                       | 450      | 2.5                    | 1 450 000             | 4 000 000              | 148 000               | 410 000                | 600             | 900   | NA4980          |
| 420                 | 560      | 140      | 4                                       | 470      | 2.5                    | 1 500 000             | 4 250 000              | 153 000               | 430 000                | 550             | 850   | NA4984          |
| 440                 | 600      | 160      | 4                                       | 490      | 2.5                    | 1 750 000             | 4 600 000              | 179 000               | 470 000                | 550             | 800   | NA4988          |

Note 1) Allowable minimum chamfer dimension r. 2) Allowable axial stroking value of inner ring against outer ring.

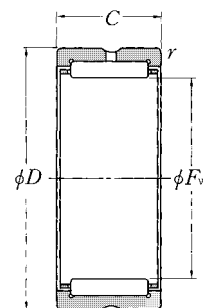


| Abutment dimensions |     |              | Mass      |
|---------------------|-----|--------------|-----------|
| $d_a$               | mm  |              | kg        |
| min                 | max | $r_{as}$ max | (approx.) |
| 311                 | 369 | 2            | 22.0      |
| 313                 | 407 | 2.5          | 42.5      |
| 331                 | 389 | 2            | 23.2      |
| 333                 | 427 | 2.5          | 45.2      |
| 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

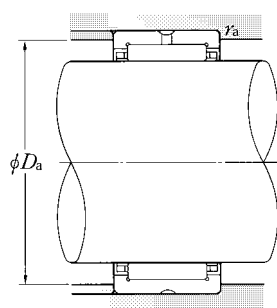
### Type MR



$F_w$  15.875~63.500mm

| Boundary dimensions       |                  |                           |                         |                | Basic load ratings |          |         |          | Limiting speeds |        |
|---------------------------|------------------|---------------------------|-------------------------|----------------|--------------------|----------|---------|----------|-----------------|--------|
| mm ( $\frac{1}{25.4}$ mm) |                  |                           |                         |                | dynamic<br>N       | static   | dynamic | static   | r/min           |        |
| $F_w$                     |                  | $D$                       | $C$                     | $r_{s \min}^1$ | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ | grease          | oil    |
|                           |                  |                           |                         |                | kgf                |          |         |          | (approx.)       |        |
| 15.875( $\frac{5}{8}$ )   | +0.027<br>+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 |
| 19.050( $\frac{3}{4}$ )   | +0.033<br>+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 |
| 22.225( $\frac{7}{8}$ )   | +0.033<br>+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 |
| 25.400(1)                 | +0.033<br>+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 |
| 28.575( $1\frac{1}{8}$ )  | +0.033<br>+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 |
| 31.750( $1\frac{1}{4}$ )  | +0.041<br>+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 |
| 34.925( $1\frac{3}{8}$ )  | +0.041<br>+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 |
| 38.100( $1\frac{1}{2}$ )  | +0.041<br>+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 |
| 41.275( $1\frac{5}{8}$ )  | +0.041<br>+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  |
| 44.450( $1\frac{3}{4}$ )  | +0.041<br>+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  |
| 47.625( $1\frac{7}{8}$ )  | +0.041<br>+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  |
| 50.800(2)                 | +0.049<br>+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  |
| 57.150( $2\frac{1}{4}$ )  | +0.049<br>+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  |
| 63.500( $2\frac{1}{2}$ )  | +0.049<br>+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  $r$ .

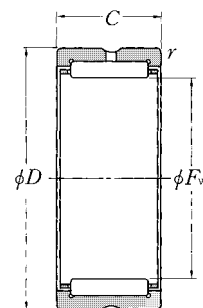


| Bearing numbers | Abutment dimensions<br>mm |                 | Mass<br>kg<br>(approx.) |
|-----------------|---------------------------|-----------------|-------------------------|
|                 | $D_a$<br>max              | $r_{as}$<br>max |                         |
| MR101812        | 24.5                      | 0.6             | 0.050                   |
| MR101816        | 24.5                      | 0.6             | 0.068                   |
| MR122012        | 26.5                      | 1               | 0.055                   |
| MR122016        | 26.5                      | 1               | 0.073                   |
| MR142212        | 30                        | 1               | 0.059                   |
| MR142216        | 30                        | 1               | 0.082                   |
| MR162412        | 33                        | 1               | 0.068                   |
| MR162416        | 33                        | 1               | 0.091                   |
| MR182616        | 36.5                      | 1               | 0.100                   |
| MR182620        | 36.5                      | 1               | 0.127                   |
| MR202816        | 39.5                      | 1               | 0.109                   |
| MR202820        | 39.5                      | 1               | 0.136                   |
| MR223016        | 42.5                      | 1               | 0.118                   |
| MR223020        | 42.5                      | 1               | 0.150                   |
| MR243316        | 46                        | 1.5             | 0.143                   |
| MR243320        | 46                        | 1.5             | 0.180                   |
| MR263516        | 49                        | 1.5             | 0.153                   |
| MR263520        | 49                        | 1.5             | 0.191                   |
| MR283716        | 52                        | 1.5             | 0.163                   |
| MR283720        | 52                        | 1.5             | 0.204                   |
| MR303920        | 55.5                      | 1.5             | 0.216                   |
| MR324116        | 58.5                      | 1.5             | 0.183                   |
| MR324120        | 58.5                      | 1.5             | 0.227                   |
| MR364824        | 69.5                      | 1.5             | 0.422                   |
| MR364828        | 69.5                      | 1.5             | 0.493                   |
| MR405224        | 74.5                      | 2               | 0.472                   |

# Inch series

## Without inner ring

### Type MR

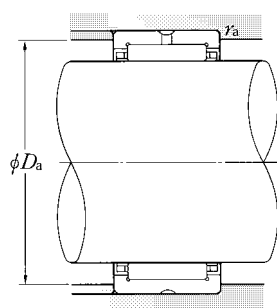


$F_w$  63.500~184.150mm

| Boundary dimensions                |                |              |               | Basic load ratings |             |                |               | Limiting speeds |       |
|------------------------------------|----------------|--------------|---------------|--------------------|-------------|----------------|---------------|-----------------|-------|
| mm                                 |                |              |               | dynamic<br>N       | static<br>N | dynamic<br>kgf | static<br>kgf | r/min           |       |
| $F_w$                              | $D$            | $C$          | $r's \min^1)$ | $C_r$              | $C_{or}$    | $C_r$          | $C_{or}$      | grease          | oil   |
| 63.500(2 1/2)<br>+0.049<br>+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 |
|                                    | 88.900(3 1/2)  | 38.10(1 1/2) | 2             | 92 000             | 173 000     | 9 400          | 17 600        | 3 700           | 5 500 |
| 69.850(2 3/4)<br>+0.049<br>+0.030  | 88.900(3 1/2)  | 44.45(1 3/4) | 2             | 107 000            | 209 000     | 10 900         | 21 300        | 3 700           | 5 500 |
|                                    | 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 |
| 76.200(3)<br>+0.049<br>+0.030      | 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 |
|                                    | 114.300(4 1/2) | 44.45(1 3/4) | 2             | 141 000            | 264 000     | 14 400         | 26 900        | 3 000           | 4 500 |
| 82.550(3 1/4)<br>+0.058<br>+0.036  | 114.300(4 1/2) | 50.80(2)     | 2             | 154 000            | 295 000     | 15 700         | 30 000        | 3 000           | 4 500 |
|                                    | 120.650(4 3/4) | 50.80(2)     | 2.5           | 162 000            | 320 000     | 16 500         | 32 500        | 2 800           | 4 200 |
|                                    | 127.000(5)     | 50.80(2)     | 2.5           | 169 000            | 345 000     | 17 200         | 35 500        | 2 600           | 3 900 |
| 88.900(3 1/2)<br>+0.058<br>+0.036  | 133.350(5 1/4) | 50.80(2)     | 2.5           | 172 000            | 360 000     | 17 500         | 37 000        | 2 500           | 3 700 |
|                                    | 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 |
| 95.250(3 3/4)<br>+0.058<br>+0.036  | 165.100(6 1/2) | 50.80(2)     | 2.5           | 227 000            | 425 000     | 23 200         | 43 000        | 2 100           | 3 100 |
|                                    | 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 |
| 101.600(4)<br>+0.058<br>+0.036     | 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 |
|                                    | 184.150(7 1/4) | 76.20(3)     | 3             | 360 000            | 775 000     | 36 500         | 79 000        | 1 800           | 2 700 |
| 107.950(4 1/4)<br>+0.058<br>+0.036 | 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 |
|                                    | 203.200(8)     | 63.50(2 1/2) | 3             | 325 000            | 680 000     | 33 000         | 69 500        | 1 600           | 2 400 |
| 114.300(4 1/2)<br>+0.058<br>+0.036 | 203.200(8)     | 76.20(3)     | 3             | 390 000            | 870 000     | 39 500         | 88 500        | 1 600           | 2 400 |
|                                    | 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  $r$ .



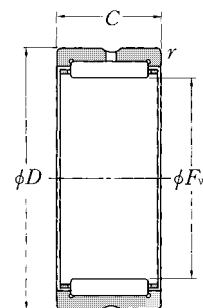


| Bearing numbers   | Abutment dimensions<br>mm |                 | Mass<br>kg<br>(approx.) |
|-------------------|---------------------------|-----------------|-------------------------|
|                   | $D_a$<br>max              | $r_{as}$<br>max |                         |
| <b>MR405228</b>   | 74.5                      | 2               | 0.533                   |
| <b>MR445616</b>   | 81                        | 2               | 0.343                   |
| <b>MR445624</b>   | 81                        | 2               | 0.504                   |
| <b>MR445628</b>   | 81                        | 2               | 0.580                   |
| <b>MR486024</b>   | 87                        | 2               | 0.558                   |
| <b>MR486028</b>   | 87                        | 2               | 0.651                   |
| <b>MR526828</b>   | 100                       | 2               | 1.02                    |
| <b>MR526832</b>   | 100                       | 2               | 1.17                    |
| <b>MR567228</b>   | 106.5                     | 2               | 1.08                    |
| <b>MR567232</b>   | 106.5                     | 2               | 1.27                    |
| <b>MR607632</b>   | 111.5                     | 2.5             | 1.28                    |
| <b>MR648032</b>   | 118                       | 2.5             | 1.29                    |
| <b>MR688432</b>   | 124.5                     | 2.5             | 1.36                    |
| <b>MR729636</b>   | 143.5                     | 2.5             | 2.62                    |
| <b>MR729640</b>   | 143.5                     | 2.5             | 2.91                    |
| <b>MR8010432</b>  | 156                       | 2.5             | 2.53                    |
| <b>MR8010436</b>  | 156                       | 2.5             | 2.87                    |
| <b>MR8010440</b>  | 156                       | 2.5             | 3.19                    |
| <b>MR8811240</b>  | 169                       | 2.5             | 3.46                    |
| <b>MR8811248</b>  | 169                       | 2.5             | 4.16                    |
| <b>MR9211648</b>  | 172                       | 3               | 4.30                    |
| <b>MR9612040</b>  | 177.5                     | 3               | 3.74                    |
| <b>MR9612048</b>  | 177.5                     | 3               | 4.49                    |
| <b>MR10412840</b> | 190                       | 3               | 4.02                    |
| <b>MR10412848</b> | 190                       | 3               | 4.82                    |
| <b>MR11614648</b> | 219                       | 3               | 7.36                    |

# Inch series

## Without inner ring

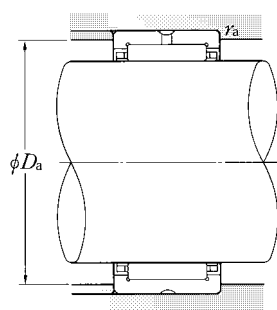
### Type MR



$F_w$  196.850~234.950mm

| Boundary dimensions                                         |                                          |          |                         |  | Basic load ratings |           |         |          | Limiting speeds |       |
|-------------------------------------------------------------|------------------------------------------|----------|-------------------------|--|--------------------|-----------|---------|----------|-----------------|-------|
| mm                                                          |                                          |          |                         |  | dynamic            | static    | dynamic | static   | r/min           |       |
| $F_w$                                                       | $D$                                      | $C$      | $r$ s min <sup>1)</sup> |  | N                  |           | kgf     |          | grease          | oil   |
|                                                             |                                          |          |                         |  | $C_r$              | $C_{or}$  | $C_r$   | $C_{or}$ | (approx.)       |       |
| 196.850(7 <sup>3</sup> / <sub>4</sub> )<br>+0.079<br>+0.050 | 244.475(9 <sup>5</sup> / <sub>8</sub> )  | 76.20(3) | 3                       |  | 455 000            | 990 000   | 46 500  | 101 000  | 1 300           | 2 000 |
| 209.550(8 <sup>1</sup> / <sub>4</sub> )<br>+0.079<br>+0.050 | 257.175(10 <sup>1</sup> / <sub>8</sub> ) | 76.20(3) | 3                       |  | 475 000            | 1 060 000 | 48 500  | 109 000  | 1 300           | 1 900 |
| 222.250(8 <sup>3</sup> / <sub>4</sub> )<br>+0.079<br>+0.050 | 269.875(10 <sup>5</sup> / <sub>8</sub> ) | 76.20(3) | 4                       |  | 495 000            | 1 140 000 | 50 500  | 116 000  | 1 200           | 1 800 |
| 234.950(9 <sup>1</sup> / <sub>4</sub> )<br>+0.079<br>+0.050 | 282.575(11 <sup>1</sup> / <sub>8</sub> ) | 76.20(3) | 4                       |  | 510 000            | 1 210 000 | 52 000  | 124 000  | 1 100           | 1 700 |

Note 1) Allowable minimum chamfer dimension  $r$ .

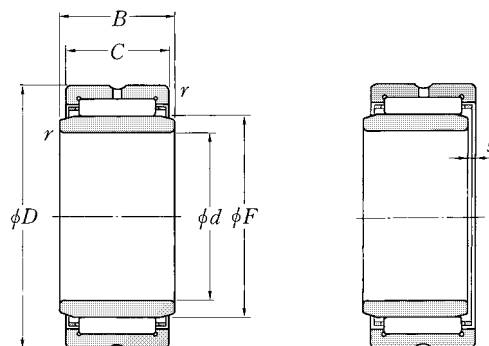


| Bearing numbers | Abutment dimensions<br>mm |                 | Mass<br>kg<br>(approx.) |
|-----------------|---------------------------|-----------------|-------------------------|
|                 | $D_a$<br>max              | $r_{as}$<br>max |                         |
| MR12415448      | 231.5                     | 3               | 7.80                    |
| MR13216248      | 244                       | 3               | 8.36                    |
| MR14017048      | 254                       | 4               | 8.81                    |
| MR14817848      | 266.5                     | 4               | 9.27                    |

# Inch series

## With inner ring

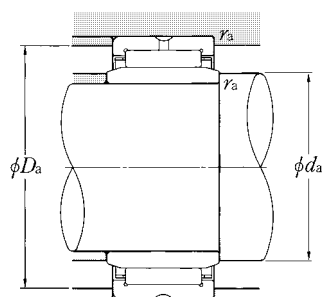
### Type MR + MI



$d$  9.525~34.925mm

| Boundary dimensions       |                           |       |                         |                          |        |                   | Basic load ratings |          |         |          |
|---------------------------|---------------------------|-------|-------------------------|--------------------------|--------|-------------------|--------------------|----------|---------|----------|
| mm ( $\frac{1}{25.4}$ mm) |                           |       |                         |                          |        |                   | dynamic            | static   | dynamic | static   |
| $d$                       | $D$                       | $B$   | $C$                     | $r$ 's min <sup>1)</sup> | $F$    | $s$ <sup>2)</sup> | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ |
| 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( $\frac{11}{16}$ ) | 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    |
|                           |                           |       |                         |                          |        |                   |                    |          |         |          |
| 19.050( $\frac{3}{4}$ )   | 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    |
|                           | 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( $\frac{13}{16}$ ) | 38.100( $1\frac{1}{2}$ )  | 25.65 | 25.40(1)                | 1                        | 25.400 | 2                 | 29 500             | 38 500   | 3 000   | 3 950    |
|                           |                           |       |                         |                          |        |                   |                    |          |         |          |
| 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( $\frac{15}{16}$ ) | 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.

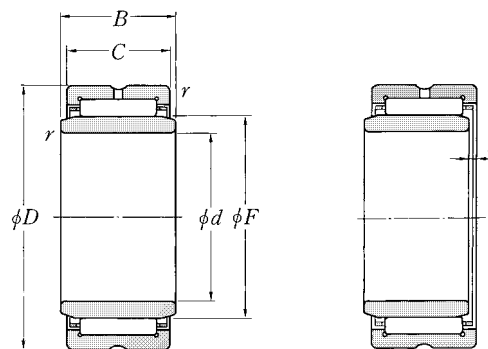


| Limiting speeds |        | Bearing numbers    | Abutment dimensions |                    |                 | Mass<br>kg<br>(approx.) |
|-----------------|--------|--------------------|---------------------|--------------------|-----------------|-------------------------|
| grease          | oil    |                    | $d_a$<br>min        | mm<br>$D_a$<br>max | $r_{as}$<br>max |                         |
| 17 000          | 25 000 | MR101812+MI-061012 | 13.5                | 24.5               | 0.6             | 0.069                   |
| 17 000          | 25 000 | MR101816+MI-061016 | 13.5                | 24.5               | 0.6             | 0.093                   |
| 14 000          | 21 000 | MR122012+MI-081212 | 17.5                | 26.5               | 1               | 0.079                   |
| 14 000          | 21 000 | MR122016+MI-081216 | 17.5                | 26.5               | 1               | 0.105                   |
| 12 000          | 18 000 | MR142212+MI-101412 | 21                  | 30                 | 1               | 0.086                   |
| 12 000          | 18 000 | MR142216+MI-101416 | 21                  | 30                 | 1               | 0.118                   |
| 12 000          | 18 000 | MR142212+MI-111412 | 21                  | 30                 | 1               | 0.079                   |
| 11 000          | 16 000 | MR162412+MI-121612 | 24                  | 33                 | 1               | 0.102                   |
| 11 000          | 16 000 | MR162416+MI-121616 | 24                  | 33                 | 1               | 0.136                   |
| 11 000          | 16 000 | MR162416+MI-131616 | 24                  | 33                 | 1               | 0.125                   |
| 9 500           | 14 000 | MR182616+MI-141816 | 27                  | 36.5               | 1               | 0.152                   |
| 9 500           | 14 000 | MR182620+MI-141820 | 27                  | 36.5               | 1               | 0.193                   |
| 9 500           | 14 000 | MR182616+MI-151816 | 27                  | 36.5               | 1               | 0.139                   |
| 9 500           | 14 000 | MR182620+MI-151820 | 27                  | 36.5               | 1               | 0.176                   |
| 8 500           | 13 000 | MR202816+MI-162016 | 30.5                | 39.5               | 1               | 0.161                   |
| 8 500           | 13 000 | MR202820+MI-162020 | 30.5                | 39.5               | 1               | 0.201                   |
| 7 500           | 11 000 | MR223016+MI-182216 | 33.5                | 42.5               | 1               | 0.181                   |
| 7 500           | 11 000 | MR223020+MI-182220 | 33.5                | 42.5               | 1               | 0.229                   |
| 7 500           | 11 000 | MR243320+MI-192420 | 35                  | 46                 | 1.5             | 0.286                   |
| 7 500           | 11 000 | MR243316+MI-202416 | 37                  | 46                 | 1.5             | 0.230                   |
| 7 500           | 11 000 | MR243320+MI-202420 | 37                  | 46                 | 1.5             | 0.285                   |
| 6 500           | 9 500  | MR263516+MI-212616 | 40                  | 49                 | 1.5             | 0.257                   |
| 6 500           | 9 500  | MR263520+MI-212620 | 40                  | 49                 | 1.5             | 0.325                   |
| 6 500           | 9 500  | MR263520+MI-222620 | 40                  | 49                 | 1.5             | 0.286                   |
| 6 000           | 9 000  | MR283716+MI-222816 | 41.5                | 52                 | 1.5             | 0.294                   |
| 6 000           | 9 000  | MR283720+MI-222820 | 41.5                | 52                 | 1.5             | 0.364                   |

# Inch series

## With inner ring

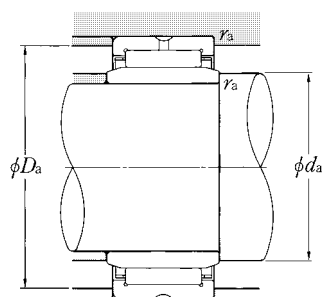
### Type MR + MI



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's min <sup>1)</sup> | F      | s <sup>2)</sup> | C <sub>r</sub>     | C <sub>or</sub> | C <sub>r</sub> | C <sub>or</sub> |
| 36.512(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           |
| 38.100(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           |
|                            | 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          |
| 39.688(1 $\frac{9}{16}$ )  | 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          |
| 41.275(1 $\frac{5}{8}$ )   | 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 | 1               | 62 000             | 114 000         | 6 300          | 11 700          |
| 42.682(1 $1\frac{1}{16}$ ) | 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          |
| 44.450(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          |
| 49.212(1 $1\frac{5}{16}$ ) | 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          |
| 50.800(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          |
| 55.562(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          |
| 57.150(2 $\frac{1}{4}$ )   | 88.900(3 $\frac{1}{2}$ )  | 25.65 | 25.40(1)                | 2                     | 69.850 | 0.5             | 66 000             | 112 000         | 6 700          | 11 400          |
|                            | 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          |
| 60.325(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          |
| 63.500(1 $\frac{1}{2}$ )   | 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          |
| 66.675(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.



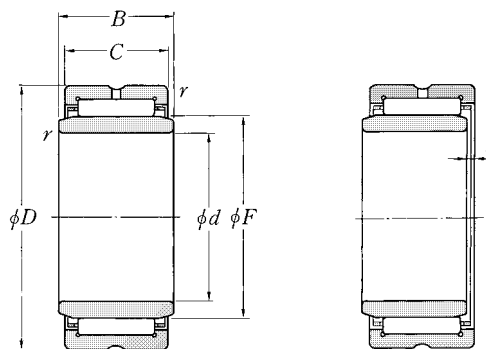
| Limiting speeds |       | Bearing numbers      | Abutment dimensions |                    |                 | Mass<br>kg<br>(approx.) |
|-----------------|-------|----------------------|---------------------|--------------------|-----------------|-------------------------|
| grease          | oil   |                      | $d_a$<br>min        | mm<br>$D_a$<br>max | $r_{as}$<br>max |                         |
| 6 000           | 9 000 | MR283716 + MI-232816 | 43                  | 52                 | 1.5             | 0.264                   |
| 6 000           | 9 000 | MR283720 + MI-232820 | 43                  | 52                 | 1.5             | 0.330                   |
| 6 000           | 9 000 | MR283716 + MI-242816 | 43                  | 52                 | 1.5             | 0.246                   |
| 6 000           | 9 000 | MR283720 + MI-242820 | 43                  | 52                 | 1.5             | 0.307                   |
| 5 500           | 8 000 | MR324120 + MI-243220 | 44.5                | 58.5               | 1.5             | 0.448                   |
| 5 500           | 8 500 | MR303920 + MI-253020 | 46.5                | 55.5               | 1.5             | 0.368                   |
| 5 500           | 8 000 | MR324120 + MI-253220 | 46                  | 58.5               | 1.5             | 0.424                   |
| 5 500           | 8 000 | MR324116 + MI-263216 | 48                  | 58.5               | 1.5             | 0.317                   |
| 5 500           | 8 000 | MR324120 + MI-263220 | 48                  | 58.5               | 1.5             | 0.402                   |
| 5 500           | 8 000 | MR324116 + MI-273216 | 49.5                | 58.5               | 1.5             | 0.300                   |
| 5 500           | 8 000 | MR324120 + MI-273220 | 49.5                | 58.5               | 1.5             | 0.373                   |
| 4 700           | 7 000 | MR364824 + MI-283624 | 51                  | 69.5               | 1.5             | 0.732                   |
| 4 700           | 7 000 | MR364828 + MI-283628 | 51                  | 69.5               | 1.5             | 0.853                   |
| 4 300           | 6 500 | MR405224 + MI-314024 | 56                  | 74.5               | 2               | 0.848                   |
| 4 300           | 6 500 | MR405228 + MI-314028 | 56                  | 74.5               | 2               | 0.975                   |
| 4 300           | 6 500 | MR405224 + MI-324024 | 59                  | 74.5               | 2               | 0.812                   |
| 4 300           | 6 500 | MR405228 + MI-324028 | 59                  | 74.5               | 2               | 0.923                   |
| 3 700           | 5 500 | MR445628 + MI-354428 | 63.5                | 81                 | 2               | 1.07                    |
| 3 700           | 5 500 | MR445616 + MI-364416 | 65                  | 81                 | 2               | 0.594                   |
| 3 700           | 5 500 | MR445624 + MI-364424 | 65                  | 81                 | 2               | 0.884                   |
| 3 700           | 5 500 | MR445628 + MI-364428 | 65                  | 81                 | 2               | 1.02                    |
| 3 300           | 5 000 | MR486028 + MI-384828 | 68                  | 87                 | 2               | 1.25                    |
| 3 300           | 5 000 | MR486024 + MI-404824 | 71.5                | 87                 | 2               | 0.978                   |
| 3 300           | 5 000 | MR486028 + MI-404828 | 71.5                | 87                 | 2               | 1.14                    |
| 3 300           | 5 000 | MR526828 + MI-425228 | 74.5                | 100                | 2               | 1.67                    |
| 3 300           | 5 000 | MR526832 + MI-425232 | 74.5                | 100                | 2               | 1.92                    |



# Inch series

## With inner ring

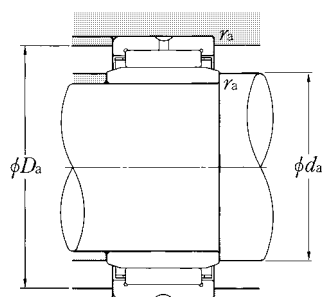
### Type MR + MI



$d$  69.850~127.000mm

| Boundary dimensions        |                           |       |                         |                          |         |                   | Basic load ratings |          |         |          |
|----------------------------|---------------------------|-------|-------------------------|--------------------------|---------|-------------------|--------------------|----------|---------|----------|
| mm ( $\frac{1}{25.4}$ mm)  |                           |       |                         |                          |         |                   | dynamic            | static   | dynamic | static   |
| $d$                        | $D$                       | $B$   | $C$                     | $r$ 's min <sup>1)</sup> | $F$     | $s$ <sup>2)</sup> | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ |
| 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   |
|                            | 114.300(4 $\frac{1}{2}$ ) | 51.05 | 50.80(2)                | 2                        | 88.900  | 5.5               | 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   |
|                            | 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   |
| 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   |
|                            | 127.000(5)                | 51.05 | 50.80(2)                | 2.5                      | 101.600 | 2.5               | 169 000            | 345 000  | 17 200  | 35 500   |
| 88.900(3 $\frac{1}{2}$ )   | 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   |
|                            | 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   |
| 92.075(3 $\frac{5}{8}$ )   | 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   |
|                            | 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   |
| 107.950(4 $\frac{1}{4}$ )  | 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   |
|                            | 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.

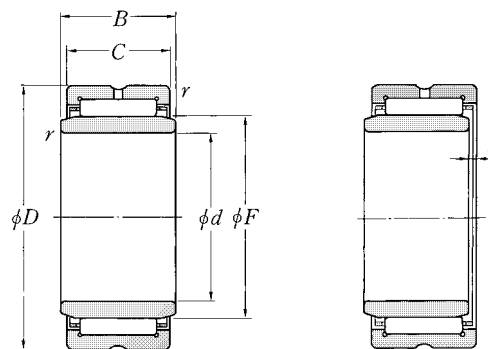


| Limiting speeds |       | Bearing numbers       | Abutment dimensions |                 |            | Mass<br>kg<br>(approx.) |
|-----------------|-------|-----------------------|---------------------|-----------------|------------|-------------------------|
| grease          | oil   |                       | da<br>min           | mm<br>Da<br>max | ras<br>max |                         |
| 3 300           | 5 000 | MR526828 + MI-445228  | 78                  | 100             | 2          | 1.55                    |
| 3 300           | 5 000 | MR526832 + MI-445232  | 78                  | 100             | 2          | 1.77                    |
| 3 000           | 4 500 | MR567232 + MI-475632  | 83                  | 106.5           | 2          | 2.00                    |
| 3 000           | 4 500 | MR567228 + MI-485628  | 84                  | 106.5           | 2          | 1.65                    |
| 3 000           | 4 500 | MR567232 + MI-485632  | 84                  | 106.5           | 2          | 1.92                    |
| 2 800           | 4 200 | MR607632 + MI-506032  | 88.5                | 111.5           | 2.5        | 2.15                    |
| 2 800           | 4 200 | MR607632 + MI-526032  | 91.5                | 111.5           | 2.5        | 1.99                    |
| 2 600           | 3 900 | MR648032 + MI-526432  | 91.5                | 118             | 2.5        | 2.39                    |
| 2 600           | 3 900 | MR648032 + MI-546432  | 94.5                | 118             | 2.5        | 2.22                    |
| 2 600           | 3 900 | MR648032 + MI-566432  | 98                  | 118             | 2.5        | 2.05                    |
| 2 500           | 3 700 | MR688432 + MI-566832  | 98                  | 124.5           | 2.5        | 2.53                    |
| 2 500           | 3 700 | MR688432 + MI-586832  | 101                 | 124.5           | 2.5        | 2.36                    |
| 2 500           | 3 700 | MR688432 + MI-606832  | 104.5               | 124.5           | 2.5        | 2.17                    |
| 2 300           | 3 500 | MR729636 + MI-607236  | 104.5               | 143.5           | 2.5        | 4.02                    |
| 2 300           | 3 500 | MR729640 + MI-607240  | 104.5               | 143.5           | 2.5        | 4.47                    |
| 2 300           | 3 500 | MR729636 + MI-627236  | 107.5               | 143.5           | 2.5        | 3.77                    |
| 2 300           | 3 500 | MR729640 + MI-627240  | 107.5               | 143.5           | 2.5        | 4.19                    |
| 2 100           | 3 100 | MR8010432 + MI-648032 | 110.5               | 156             | 2.5        | 3.60                    |
| 2 100           | 3 100 | MR8010436 + MI-648036 | 110.5               | 156             | 2.5        | 4.92                    |
| 2 100           | 3 100 | MR8010440 + MI-648040 | 110.5               | 156             | 2.5        | 5.47                    |
| 2 100           | 3 100 | MR8010436 + MI-688036 | 117                 | 156             | 2.5        | 4.44                    |
| 1 900           | 2 900 | MR8811240 + MI-728840 | 123.5               | 169             | 2.5        | 6.04                    |
| 1 900           | 2 900 | MR8811248 + MI-728848 | 123.5               | 169             | 2.5        | 7.26                    |
| 1 800           | 2 700 | MR9211648 + MI-769248 | 132                 | 172             | 3          | 7.48                    |
| 1 700           | 2 600 | MR9612040 + MI-809640 | 140                 | 177.5           | 3          | 6.54                    |
| 1 700           | 2 600 | MR9612048 + MI-809648 | 140                 | 177.5           | 3          | 7.84                    |

# Inch series

## With inner ring

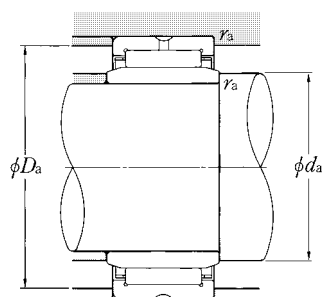
### Type MR + MI



$d$  139.700~203.200mm

| Boundary dimensions                        |                            |       |                         |                          |         |                   | Basic load ratings |           |         |          |
|--------------------------------------------|----------------------------|-------|-------------------------|--------------------------|---------|-------------------|--------------------|-----------|---------|----------|
| mm ( $\frac{1}{25.4}$ mm)                  |                            |       |                         |                          |         |                   | dynamic            | static    | dynamic | static   |
| $d$                                        | $D$                        | $B$   | $C$                     | $r$ 's min <sup>1)</sup> | $F$     | $s$ <sup>2)</sup> | $C_r$              | $C_{or}$  | $C_r$   | $C_{or}$ |
| <b>139.700(5 <math>\frac{1}{2}</math>)</b> | 203.200( 8)                | 63.88 | 63.50(2 $\frac{1}{2}$ ) | 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 $\frac{1}{8}$ ) | 76.58 | 76.20(3)                | 3                        | 184.150 | 8.5               | 435 000            | 915 000   | 44 500  | 93 000   |
| <b>165.100(6 <math>\frac{1}{2}</math>)</b> | 244.475( 9 $\frac{5}{8}$ ) | 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 $\frac{1}{8}$ ) | 76.58 | 76.20(3)                | 3                        | 209.550 | 8.5               | 475 000            | 1 060 000 | 48 500  | 109 000  |
| <b>190.500(7 <math>\frac{1}{2}</math>)</b> | 269.875(10 $\frac{5}{8}$ ) | 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 $\frac{1}{8}$ ) | 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.

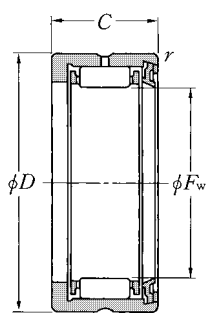
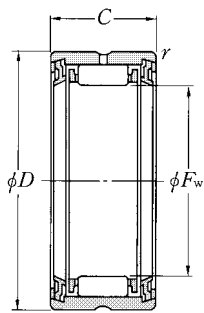
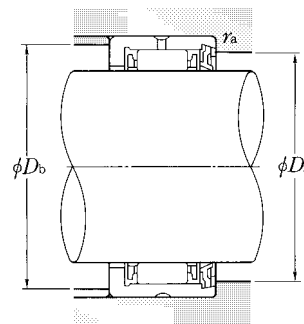


| Limiting speeds |       | Bearing numbers               | Abutment dimensions |                    |                 | Mass<br>kg<br>(approx.) |
|-----------------|-------|-------------------------------|---------------------|--------------------|-----------------|-------------------------|
| grease          | oil   |                               | $d_a$<br>min        | mm<br>$D_a$<br>max | $r_{as}$<br>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

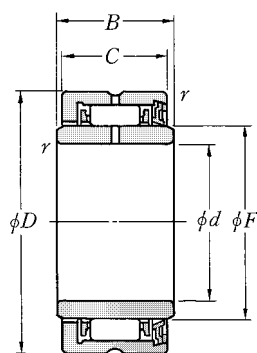
| Boundary dimensions             |     |     |                   | Basic load ratings |          |         |          | Limiting speeds<br>r/min<br>grease | Bearing numbers  |                   | Abutment dimensions |       |          | Mass      |
|---------------------------------|-----|-----|-------------------|--------------------|----------|---------|----------|------------------------------------|------------------|-------------------|---------------------|-------|----------|-----------|
|                                 |     |     |                   | dynamic            | static   | dynamic | static   |                                    |                  |                   | mm                  |       |          |           |
| mm                              |     |     |                   | N                  |          | kgf     |          |                                    |                  |                   | $D_a$               | $D_b$ | $r_{as}$ |           |
| $F_w$                           | $D$ | $C$ | $r_{s\ min}^{1)}$ | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ |                                    | Type<br>RNA49··L | Type<br>RNA49··LL | max                 | max   | max      | (approx.) |
| 14 <sup>+0.027<br/>+0.016</sup> | 22  | 13  | 0.3               | 7 200              | 8 500    | 735     | 865      | 10 000                             | RNA4900L         | RNA4900LL         | 16                  | 20    | 0.3      | 0.016     |
| 16 <sup>+0.027<br/>+0.016</sup> | 24  | 13  | 0.3               | 7 750              | 9 700    | 795     | 990      | 10 000                             | RNA4901L         | RNA4901LL         | 18                  | 22    | 0.3      | 0.018     |
| 20 <sup>+0.033<br/>+0.020</sup> | 28  | 13  | 0.3               | 8 300              | 11 200   | 845     | 1 150    | 10 000                             | RNA4902L         | RNA4902LL         | 22                  | 26    | 0.3      | 0.022     |
| 22 <sup>+0.033<br/>+0.020</sup> | 30  | 13  | 0.3               | 8 500              | 11 900   | 865     | 1 220    | 9 000                              | RNA4903L         | RNA4903LL         | 24                  | 28    | 0.3      | 0.022     |
| 25 <sup>+0.033<br/>+0.020</sup> | 37  | 17  | 0.3               | 15 200             | 19 900   | 1 550   | 2 030    | 8 000                              | RNA4904L         | RNA4904LL         | 28                  | 35    | 0.3      | 0.055     |
| 30 <sup>+0.033<br/>+0.020</sup> | 42  | 17  | 0.3               | 16 000             | 22 600   | 1 640   | 2 300    | 6 500                              | RNA4905L         | RNA4905LL         | 33                  | 40    | 0.3      | 0.063     |
| 35 <sup>+0.041<br/>+0.025</sup> | 47  | 17  | 0.3               | 18 000             | 27 400   | 1 830   | 2 800    | 5 500                              | RNA4906L         | RNA4906LL         | 38                  | 45    | 0.3      | 0.072     |
| 42 <sup>+0.041<br/>+0.025</sup> | 55  | 20  | 0.6               | 22 700             | 39 500   | 2 320   | 4 000    | 4 800                              | RNA4907L         | RNA4907LL         | 45                  | 51    | 0.6      | 0.113     |
| 48 <sup>+0.041<br/>+0.025</sup> | 62  | 22  | 0.6               | 27 800             | 53 500   | 2 830   | 5 450    | 4 200                              | RNA4908L         | RNA4908LL         | 51                  | 58    | 0.6      | 0.154     |
| 52 <sup>+0.049<br/>+0.030</sup> | 68  | 22  | 0.6               | 28 600             | 57 000   | 2 920   | 5 800    | 3 800                              | RNA4909L         | RNA4909LL         | 55                  | 64    | 0.6      | 0.157     |
| 58 <sup>+0.049<br/>+0.030</sup> | 72  | 22  | 0.6               | 30 500             | 64 000   | 3 100   | 6 500    | 3 400                              | RNA4910L         | RNA4910LL         | 61                  | 68    | 0.6      | 0.160     |

Note 1) Allowable minimum chamfer dimension  $r$ .

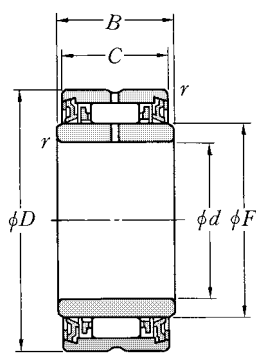
# With inner ring

## Type NA49··L

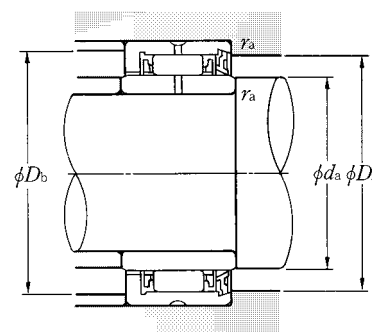
## Type NA49··LL



**Type NA49··L**  
(With single seal)



**Type NA49··LL**  
(With double seal)



$d$  10~50mm

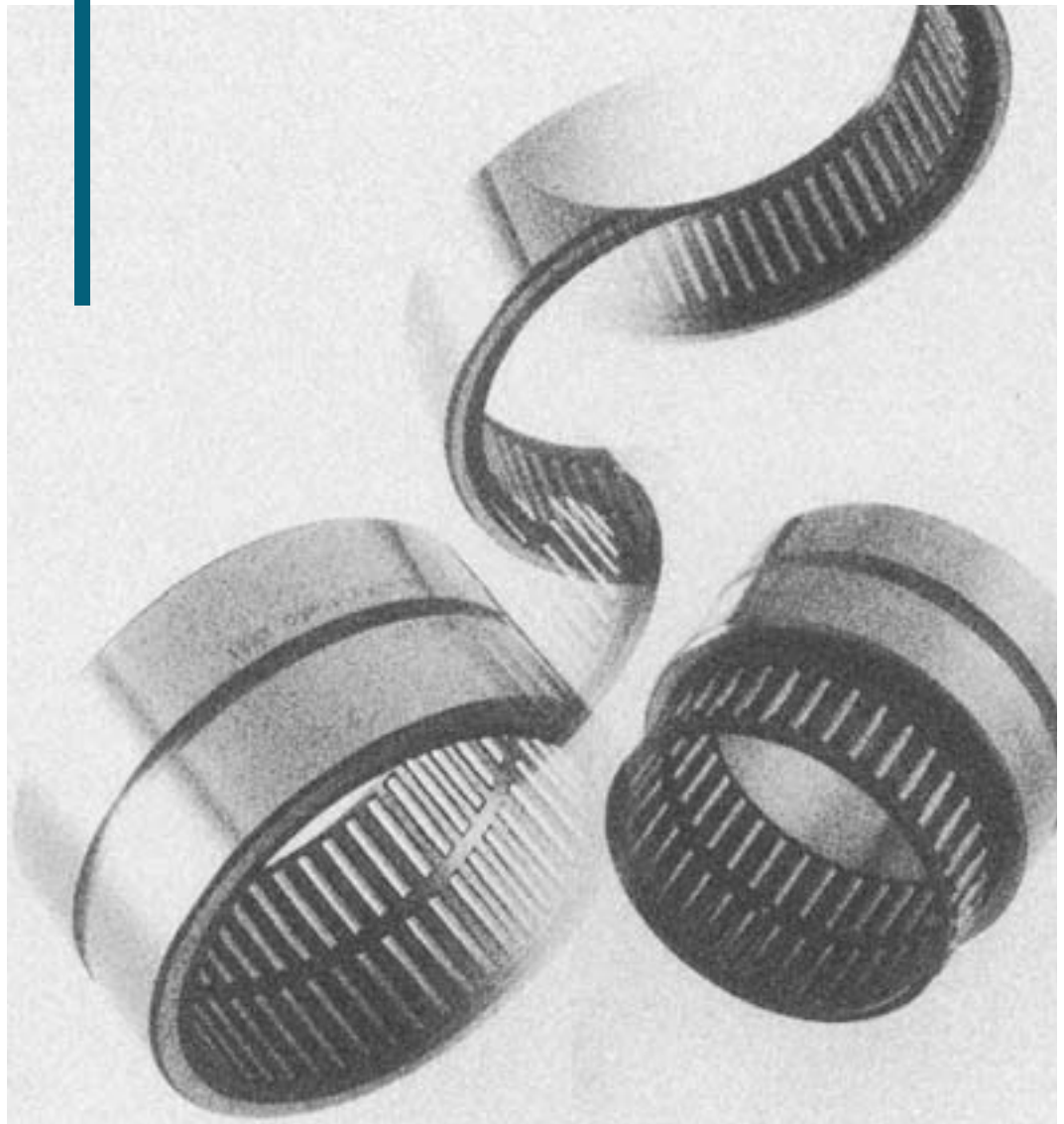
| Boundary dimensions |     |     |     |                   |     | Basic load ratings |          |         |          | Limiting<br>speeds<br>r/min<br>grease | Bearing numbers |           | Abutment<br>dimensions<br>mm |       |       |          | Mass<br>kg<br>(approx.) |
|---------------------|-----|-----|-----|-------------------|-----|--------------------|----------|---------|----------|---------------------------------------|-----------------|-----------|------------------------------|-------|-------|----------|-------------------------|
| mm                  |     |     |     |                   |     | dynamic            | static   | dynamic | static   |                                       | Type            | Type      | $d_a$                        | $D_a$ | $D_b$ | $r_{as}$ |                         |
| $d$                 | $D$ | $B$ | $C$ | $r_{s \min}^{1)}$ | $F$ | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ |                                       | NA49··L         | RNA49··LL | min                          | max   | max   | max      |                         |
| 10                  | 22  | 14  | 13  | 0.3               | 14  | 7 200              | 8 500    | 735     | 865      | 10 000                                | NA4900L         | NA4900LL  | 12                           | 16    | 20    | 0.3      | 0.025                   |
| 12                  | 24  | 14  | 13  | 0.3               | 16  | 7 750              | 9 700    | 795     | 990      | 10 000                                | NA4901L         | NA4901LL  | 14                           | 18    | 22    | 0.3      | 0.028                   |
| 15                  | 28  | 14  | 13  | 0.3               | 20  | 8 300              | 11 200   | 845     | 1 150    | 10 000                                | NA4902L         | NA4902LL  | 17                           | 22    | 26    | 0.3      | 0.036                   |
| 17                  | 30  | 14  | 13  | 0.3               | 22  | 8 500              | 11 900   | 865     | 1 220    | 9 000                                 | NA4903L         | NA4903LL  | 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         | NA4904LL  | 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         | NA4905LL  | 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         | NA4906LL  | 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         | NA4907LL  | 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         | NA4908LL  | 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         | NA4909LL  | 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         | NA4910LL  | 54                           | 61    | 68    | 0.6      | 0.295                   |

Note 1) Allowable minimum chamfer dimension  $r^*$ .





## Machined Ring Needle Roller Bearings, Separable Type



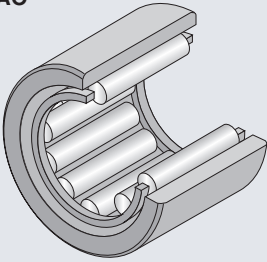
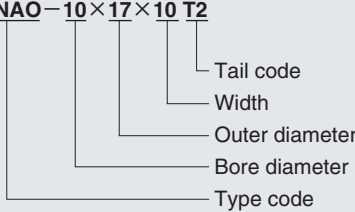
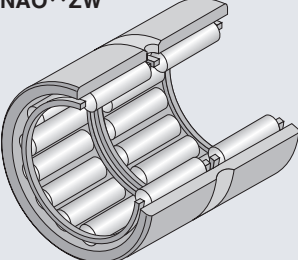
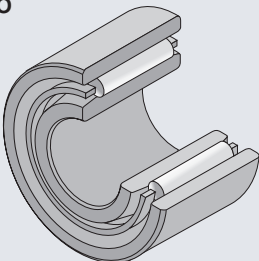
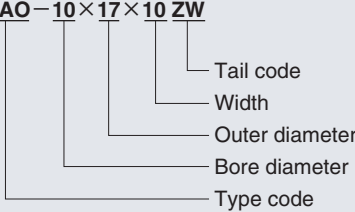
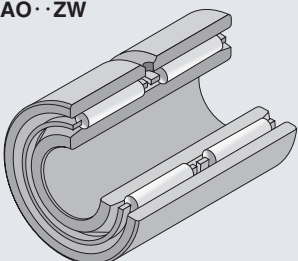
## Machined Ring Needle Roller Bearings, Separable Type

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 so designed that the needle roller and cage assembly can be guided by a shaft or a housing. Furthermore, the outer ring, the needle roller

and cage assembly separable from one another, and the inner ring can be press-fitted individually in a shaft or a housing. This could facilitate the bearing mounting work.

This bearing type is suitable for an application requiring high running accuracy because the resultant radial clearance can be retained in a narrow range by selection and combination of appropriate inner ring, outer ring and needle roller and cage assembly.

| Bearing type                                                                                                | Applied shaft diameter (mm) | Composition of nominal bearing number                                                                          | Remarks                                                                                                                                                                                                                                                                                                                                          |
|-------------------------------------------------------------------------------------------------------------|-----------------------------|----------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Type RNAO</b><br>       | $\phi 5 \sim \phi 100$      | <b>RNAO-10×17×10 T2</b><br> | <p>Bearing with tail code 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 an application requiring high running accuracy, manufacture of the bearings conforming to JIS Class-6, -5 and -4 is also available on special request.</p> |
| <b>Type RNAO · ZW</b><br> | $\phi 8 \sim \phi 80$       | <b>[Tail code]</b><br>T2 : Resin cage<br>ZW: Double-row type                                                   |                                                                                                                                                                                                                                                                                                                                                  |
| <b>Type NAO</b><br>      | $\phi 8 \sim \phi 90$       | <b>NAO-10×17×10 ZW</b><br> |                                                                                                                                                                                                                                                                                                                                                  |
| <b>Type NAO · ZW</b><br> | $\phi 10 \sim \phi 70$      | <b>[Tail code]</b><br>T2 : Resin cage<br>ZW: Double-row type                                                   |                                                                                                                                                                                                                                                                                                                                                  |

### 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.

Particularly when high bearing accuracy is required, a bearing with grinding allowance for its inner ring raceway surface can be supplied upon request from a client. In that case, however, the client is requested to finish the inner ring to the intended dimension after having installed on a shaft.

### Radial clearance and bearing fits

**Table 5.1** of Subsection 5.1 "Radial Clearance in Bearings" (page A-30) shows the radial clearance of bearings with inner ring. 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 respective fitting tolerances for shaft and housing bore on/in which bearing with inner ring is press-fitted are per **Table 6.3** of 6.4 "Recommended Bearing Fits" (page A-34) which specifies them according to load characteristic, load magnitude, and shaft and housing bore sizes.

The profile accuracy and surface roughness of shaft and housing to be applied are as specified in **Table 7.3** of 7.3 "Shaft and Housing Accuracy" (page A-39).

A shaft is used as the direct raceway surface for a bearing without inner ring and, in this case, the shaft diameter (raceway diameter) tolerance is per Table 1 specifying the tolerances according to each running clearance. And K7 tolerance generally in broad use is applied as the dimensional tolerance for the housing bore. Feel free to contact NTN for application of housing bore tolerance other than K7.

For the profile accuracy, surface roughness and hardness of a shaft acting as the raceway surface, refer to **Table 7.4** of 7.4 "Raceway Surface Accuracy" (page A-39).

### Dimension of oil hole in 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 every outer ring diameter.

**Table 1 Oil hole dimension**

| Outer ring outer diameter |       | Oil hole dia.<br>(mm) | Number of<br>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

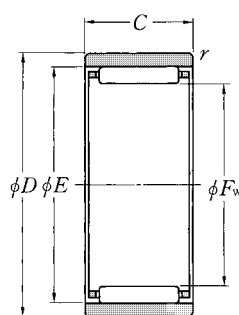
The inner ring and outer ring of any machined ring needle roller bearing, separable type must both be positioned in axial direction by shoulder or a snap ring.

For the shoulder dimension and corner roundness ( $r_a$ ) of the shaft and the housing are as specified in applicable "Dimensions 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.

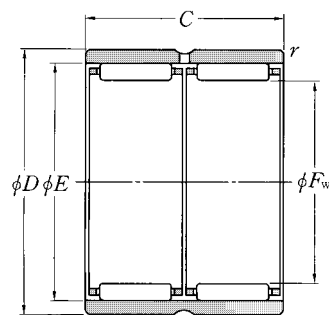
## Without inner ring

## Type RNAO

## Type RNAO · · ZW



Type RNAO

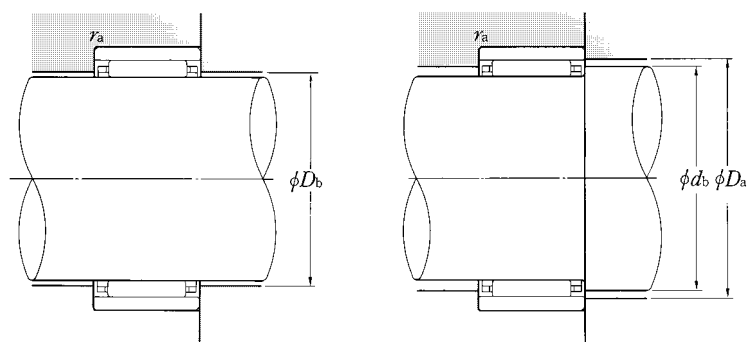


Type RNAO · · ZW

 $F_w$  5~20mm

| Boundary dimensions |                                                          |       |                  |      | Basic load ratings |        |         |        | Limiting speeds |        | Bearing numbers |                   |
|---------------------|----------------------------------------------------------|-------|------------------|------|--------------------|--------|---------|--------|-----------------|--------|-----------------|-------------------|
| mm                  |                                                          |       |                  |      | dynamic            | static | dynamic | static | r/min           |        |                 |                   |
| $F_w$               | $D$                                                      | $C$   | $r_{s\min}^{1)}$ | $E$  | N                  |        | kgf     |        | grease          | oil    |                 |                   |
| $C_r$               | $C_{or}$                                                 | $C_r$ | $C_{or}$         |      |                    |        |         |        |                 |        |                 |                   |
| 5                   | $\begin{smallmatrix} +0.018 \\ +0.010 \end{smallmatrix}$ | 10    | 8                | 0.15 | 8                  | 2 640  | 2 190   | 269    | 224             | 27 000 | 40 000          | RNAO- 5×10×8T2    |
| 6                   | $\begin{smallmatrix} +0.018 \\ +0.010 \end{smallmatrix}$ | 13    | 8                | 0.3  | 9                  | 2 660  | 2 280   | 272    | 233             | 25 000 | 37 000          | RNAO- 6×13×8T2    |
| 7                   | $\begin{smallmatrix} +0.022 \\ +0.013 \end{smallmatrix}$ | 14    | 8                | 0.3  | 10                 | 2 670  | 2 350   | 272    | 239             | 23 000 | 34 000          | RNAO- 7×14×8T2    |
| 8                   | $\begin{smallmatrix} +0.022 \\ +0.013 \end{smallmatrix}$ | 15    | 10               | 0.3  | 11                 | 4 000  | 4 100   | 410    | 420             | 21 000 | 32 000          | RNAO- 8×15×10T2   |
|                     |                                                          | 16    | 20               | 0.3  | 12                 | 7 950  | 8 350   | 810    | 850             | 21 000 | 32 000          | RNAO- 8×16×20ZWT2 |
| 10                  | $\begin{smallmatrix} +0.022 \\ +0.013 \end{smallmatrix}$ | 17    | 10               | 0.3  | 13                 | 4 550  | 5 100   | 460    | 520             | 19 000 | 28 000          | RNAO-10×17×10T2   |
|                     |                                                          | 20    | 12               | 0.3  | 16                 | 7 100  | 5 950   | 720    | 610             | 19 000 | 28 000          | RNAO-10×20×12     |
| 12                  | $\begin{smallmatrix} +0.027 \\ +0.016 \end{smallmatrix}$ | 19    | 13.5             | 0.3  | 15                 | 6 000  | 7 700   | 615    | 785             | 17 000 | 26 000          | RNAO-12×19×13.5   |
|                     |                                                          | 22    | 12               | 0.3  | 18                 | 8 650  | 8 000   | 880    | 815             | 17 000 | 26 000          | RNAO-12×22×12     |
| 14                  | $\begin{smallmatrix} +0.027 \\ +0.016 \end{smallmatrix}$ | 22    | 13               | 0.3  | 18                 | 8 300  | 10 100  | 845    | 1 030           | 16 000 | 24 000          | RNAO-14×22×13     |
|                     |                                                          | 22    | 20               | 0.3  | 18                 | 11 800 | 16 000  | 1 210  | 1 630           | 16 000 | 24 000          | RNAO-14×22×20ZW   |
|                     |                                                          | 26    | 12               | 0.3  | 20                 | 9 350  | 9 150   | 955    | 930             | 16 000 | 24 000          | RNAO-14×26×12     |
| 15                  | $\begin{smallmatrix} +0.027 \\ +0.016 \end{smallmatrix}$ | 23    | 13               | 0.3  | 19                 | 8 250  | 10 200  | 840    | 1 040           | 15 000 | 23 000          | RNAO-15×23×13     |
|                     |                                                          | 23    | 20               | 0.3  | 19                 | 11 700 | 16 100  | 1 200  | 1 640           | 15 000 | 23 000          | RNAO-15×23×20ZW   |
| 16                  | $\begin{smallmatrix} +0.027 \\ +0.016 \end{smallmatrix}$ | 24    | 13               | 0.3  | 20                 | 9 050  | 11 800  | 925    | 1 200           | 15 000 | 23 000          | RNAO-16×24×13     |
|                     |                                                          | 24    | 20               | 0.3  | 20                 | 12 900 | 18 500  | 1 310  | 1 890           | 15 000 | 23 000          | RNAO-16×24×20ZW   |
|                     |                                                          | 28    | 12               | 0.3  | 22                 | 11 700 | 12 500  | 1 190  | 1 280           | 15 000 | 23 000          | RNAO-16×28×12     |
| 17                  | $\begin{smallmatrix} +0.027 \\ +0.016 \end{smallmatrix}$ | 25    | 13               | 0.3  | 21                 | 9 400  | 12 600  | 960    | 1 280           | 15 000 | 22 000          | RNAO-17×25×13     |
|                     |                                                          | 25    | 20               | 0.3  | 21                 | 12 800 | 18 600  | 1 300  | 1 900           | 15 000 | 22 000          | RNAO-17×25×20ZW   |
|                     |                                                          | 25    | 26               | 0.3  | 21                 | 16 100 | 25 200  | 1 640  | 2 570           | 15 000 | 22 000          | RNAO-17×25×26ZW   |
| 18                  | $\begin{smallmatrix} +0.027 \\ +0.016 \end{smallmatrix}$ | 26    | 13               | 0.3  | 22                 | 8 900  | 11 900  | 910    | 1 210           | 14 000 | 21 000          | RNAO-18×26×13     |
|                     |                                                          | 26    | 20               | 0.3  | 22                 | 12 700 | 18 800  | 1 290  | 1 910           | 14 000 | 21 000          | RNAO-18×26×20ZW   |
|                     |                                                          | 30    | 12               | 0.3  | 24                 | 12 300 | 13 800  | 1 250  | 1 410           | 14 000 | 21 000          | RNAO-18×30×12     |
|                     |                                                          | 30    | 24               | 0.3  | 24                 | 21 100 | 27 700  | 2 150  | 2 820           | 14 000 | 21 000          | RNAO-18×30×24ZW   |
| 20                  | $\begin{smallmatrix} +0.033 \\ +0.020 \end{smallmatrix}$ | 28    | 13               | 0.3  | 24                 | 10 000 | 14 300  | 1 020  | 1 460           | 13 000 | 20 000          | RNAO-20×28×13     |
|                     |                                                          | 28    | 26               | 0.3  | 24                 | 17 100 | 28 600  | 1 750  | 2 910           | 13 000 | 20 000          | RNAO-20×28×26ZW   |
|                     |                                                          | 32    | 12               | 0.3  | 26                 | 12 900 | 15 100  | 1 320  | 1 540           | 13 000 | 20 000          | RNAO-20×32×12     |

Note 1) Allowable minimum chamfer dimension  $r$ .

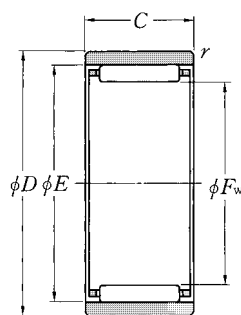


| $d_b$ | Abutment dimensions<br>mm |       |                 | Mass<br>kg<br>(approx.) |
|-------|---------------------------|-------|-----------------|-------------------------|
|       | $D_a$<br>max              | $D_b$ | $r_{as}$<br>max |                         |
| 7.7   | 8.8                       | 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                   |

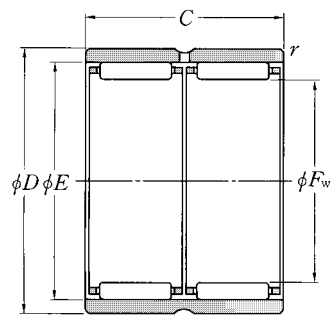
## Without inner ring

## Type RNAO

## Type RNAO··ZW



Type RNAO

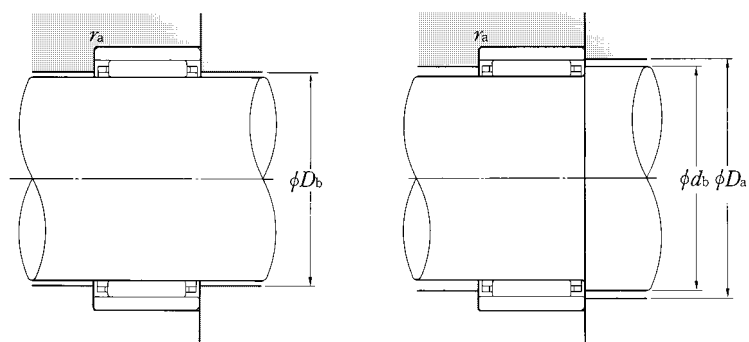


Type RNAO··ZW

 $F_w$  20~40mm

| Boundary dimensions |                      |       |                  |     |    | Basic load ratings |        |         |        | Limiting speeds |        | Bearing numbers |
|---------------------|----------------------|-------|------------------|-----|----|--------------------|--------|---------|--------|-----------------|--------|-----------------|
| mm                  |                      |       |                  |     |    | dynamic            | static | dynamic | static | r/min           |        |                 |
| $F_w$               | $D$                  | $C$   | $r_{s\min}^{1)}$ | $E$ |    | N                  |        | kgf     |        | grease          | oil    |                 |
| $C_r$               | $C_{or}$             | $C_r$ | $C_{or}$         |     |    |                    |        |         |        |                 |        |                 |
| 20                  | $+0.033$<br>$+0.020$ | 32    | 24               | 0.3 | 26 | 22 100             | 30 000 | 2 260   | 3 100  | 13 000          | 20 000 | RNAO-20×32×24ZW |
| 22                  | $+0.033$<br>$+0.020$ | 30    | 13               | 0.3 | 26 | 10 200             | 15 200 | 1 040   | 1 550  | 12 000          | 18 000 | RNAO-22×30×13   |
|                     |                      | 30    | 26               | 0.3 | 26 | 17 500             | 30 500 | 1 790   | 3 100  | 12 000          | 18 000 | RNAO-22×30×26ZW |
|                     |                      | 35    | 16               | 0.3 | 29 | 18 700             | 22 700 | 1 910   | 2 310  | 12 000          | 18 000 | RNAO-22×35×16   |
|                     |                      | 35    | 32               | 0.3 | 29 | 32 000             | 45 500 | 3 300   | 4 650  | 12 000          | 18 000 | RNAO-22×35×32ZW |
| 25                  | $+0.033$<br>$+0.020$ | 35    | 17               | 0.3 | 29 | 14 200             | 24 000 | 1 450   | 2 450  | 11 000          | 16 000 | RNAO-25×35×17   |
|                     |                      | 35    | 26               | 0.3 | 29 | 18 400             | 33 500 | 1 880   | 3 450  | 11 000          | 16 000 | RNAO-25×35×26ZW |
|                     |                      | 37    | 16               | 0.3 | 32 | 19 500             | 24 700 | 1 990   | 2 520  | 11 000          | 16 000 | RNAO-25×37×16   |
|                     |                      | 37    | 32               | 0.3 | 32 | 33 500             | 49 500 | 3 400   | 5 050  | 11 000          | 16 000 | RNAO-25×37×32ZW |
| 26                  | $+0.033$<br>$+0.020$ | 39    | 13               | 0.3 | 30 | 11 800             | 19 200 | 1 200   | 1 960  | 10 000          | 15 000 | RNAO-26×39×13   |
| 28                  | $+0.033$<br>$+0.020$ | 40    | 16               | 0.3 | 35 | 21 200             | 28 400 | 2 160   | 2 900  | 9 500           | 14 000 | RNAO-28×40×16   |
|                     |                      | 40    | 32               | 0.3 | 35 | 36 500             | 57 000 | 3 700   | 5 800  | 9 500           | 14 000 | RNAO-28×40×32ZW |
| 30                  | $+0.033$<br>$+0.020$ | 40    | 17               | 0.3 | 35 | 19 400             | 32 500 | 1 970   | 3 350  | 9 000           | 13 000 | RNAO-30×40×17   |
|                     |                      | 40    | 26               | 0.3 | 35 | 25 200             | 46 000 | 2 570   | 4 650  | 9 000           | 13 000 | RNAO-30×40×26ZW |
|                     |                      | 42    | 16               | 0.3 | 37 | 21 900             | 30 500 | 2 230   | 3 100  | 9 000           | 13 000 | RNAO-30×42×16   |
|                     |                      | 42    | 32               | 0.3 | 37 | 37 500             | 60 500 | 3 850   | 6 200  | 9 000           | 13 000 | RNAO-30×42×32ZW |
| 32                  | $+0.041$<br>$+0.025$ | 42    | 13               | 0.3 | 37 | 14 500             | 23 000 | 1 480   | 2 350  | 8 500           | 13 000 | RNAO-32×42×13   |
| 35                  | $+0.041$<br>$+0.025$ | 45    | 13               | 0.3 | 40 | 15 200             | 25 100 | 1 550   | 2 560  | 7 500           | 11 000 | RNAO-35×45×13   |
|                     |                      | 45    | 17               | 0.3 | 40 | 20 000             | 36 000 | 2 040   | 3 650  | 7 500           | 11 000 | RNAO-35×45×17   |
|                     |                      | 45    | 26               | 0.3 | 40 | 26 100             | 50 000 | 2 660   | 5 100  | 7 500           | 11 000 | RNAO-35×45×26ZW |
|                     |                      | 47    | 16               | 0.3 | 42 | 24 100             | 36 000 | 2 450   | 3 650  | 7 500           | 11 000 | RNAO-35×47×16   |
|                     |                      | 47    | 18               | 0.3 | 42 | 24 700             | 37 000 | 2 510   | 3 750  | 7 500           | 11 000 | RNAO-35×47×18   |
|                     |                      | 47    | 32               | 0.3 | 42 | 41 500             | 71 500 | 4 200   | 7 300  | 7 500           | 11 000 | RNAO-35×47×32ZW |
| 37                  | $+0.041$<br>$+0.025$ | 47    | 13               | 0.3 | 42 | 15 900             | 27 100 | 1 620   | 2 770  | 7 000           | 11 000 | RNAO-37×47×13   |
|                     |                      | 52    | 18               | 0.3 | 44 | 26 300             | 41 000 | 2 680   | 4 150  | 7 000           | 11 000 | RNAO-37×52×18   |
| 40                  | $+0.041$<br>$+0.025$ | 50    | 17               | 0.3 | 45 | 21 800             | 41 500 | 2 220   | 4 250  | 6 500           | 10 000 | RNAO-40×50×17   |
|                     |                      | 50    | 34               | 0.3 | 45 | 37 500             | 83 000 | 3 800   | 8 500  | 6 500           | 10 000 | RNAO-40×50×34ZW |
|                     |                      | 55    | 20               | 0.3 | 47 | 31 000             | 51 500 | 3 150   | 5 250  | 6 500           | 10 000 | RNAO-40×55×20   |

Note 1) Allowable minimum chamfer dimension  $r$ .



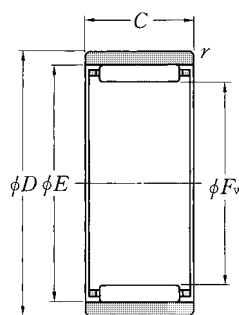
| $d_b$ | Abutment dimensions<br>mm |       |                 | Mass<br>kg<br>(approx.) |
|-------|---------------------------|-------|-----------------|-------------------------|
|       | $D_a$<br>max              | $D_b$ | $r_{as}$<br>max |                         |
| 25.6  | 30                        | 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                   |



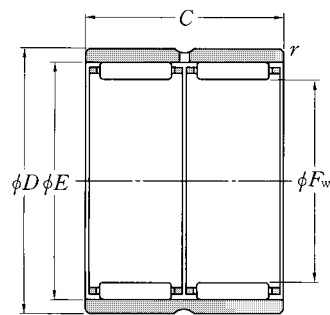
## Without inner ring

## Type RNAO

## Type RNAO··ZW



Type RNAO

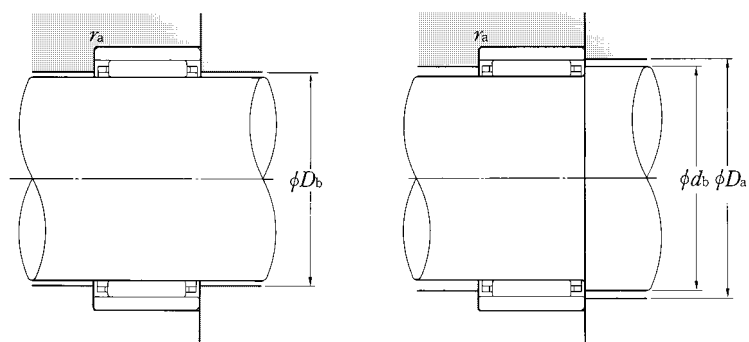


Type RNAO··ZW

 $F_w$  40~85mm

| Boundary dimensions |                      |     |                  |     |    | Basic load ratings |          |         |          | Limiting speeds |        | Bearing numbers  |  |
|---------------------|----------------------|-----|------------------|-----|----|--------------------|----------|---------|----------|-----------------|--------|------------------|--|
|                     |                      |     |                  |     |    | dynamic            | static   | dynamic | static   |                 |        |                  |  |
| mm                  |                      |     |                  |     |    | N                  |          | kgf     |          | r/min           |        |                  |  |
| $F_w$               | $D$                  | $C$ | $r_{s\min}^{1)}$ | $E$ |    | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ | grease          | oil    |                  |  |
| 40                  | $+0.041$<br>$+0.025$ | 55  | 40               | 0.3 | 48 | 56 500             | 102 000  | 5 750   | 10 400   | 6 500           | 10 000 | RNAO-40× 55×40ZW |  |
|                     |                      | 55  | 17               | 0.3 | 50 | 22 300             | 44 500   | 2 280   | 4 550    | 6 000           | 9 000  | RNAO-45× 55×17   |  |
| 45                  | $+0.041$<br>$+0.025$ | 55  | 34               | 0.3 | 50 | 38 500             | 89 500   | 3 900   | 9 100    | 6 000           | 9 000  | RNAO-45× 55×34ZW |  |
|                     |                      | 62  | 20               | 0.3 | 53 | 36 000             | 59 000   | 3 650   | 6 000    | 6 000           | 9 000  | RNAO-45× 62×20   |  |
|                     |                      | 62  | 40               | 0.3 | 53 | 61 500             | 118 000  | 6 250   | 12 000   | 6 000           | 9 000  | RNAO-45× 62×40ZW |  |
|                     |                      | 62  | 20               | 0.3 | 55 | 27 900             | 62 000   | 2 850   | 6 300    | 5 500           | 8 000  | RNAO-50× 62×20   |  |
| 50                  | $+0.041$<br>$+0.025$ | 62  | 40               | 0.3 | 55 | 48 000             | 124 000  | 4 900   | 12 600   | 5 500           | 8 000  | RNAO-50× 62×40ZW |  |
|                     |                      | 65  | 20               | 0.3 | 58 | 38 500             | 67 500   | 3 950   | 6 850    | 5 500           | 8 000  | RNAO-50× 65×20   |  |
|                     |                      | 65  | 40               | 0.6 | 58 | 66 500             | 135 000  | 6 750   | 13 700   | 5 500           | 8 000  | RNAO-50× 65×40ZW |  |
|                     |                      | 68  | 20               | 0.6 | 60 | 28 800             | 66 500   | 2 940   | 6 750    | 4 800           | 7 500  | RNAO-55× 68×20   |  |
| 55                  | $+0.049$<br>$+0.030$ | 68  | 25               | 0.6 | 63 | 50 500             | 97 500   | 5 150   | 9 950    | 4 800           | 7 500  | RNAO-55× 68×25   |  |
|                     |                      | 68  | 40               | 0.6 | 60 | 49 500             | 133 000  | 5 050   | 13 500   | 4 800           | 7 500  | RNAO-55× 68×40ZW |  |
|                     |                      | 72  | 20               | 0.6 | 63 | 39 000             | 70 000   | 3 950   | 7 100    | 4 800           | 7 500  | RNAO-55× 72×20   |  |
|                     |                      | 72  | 40               | 0.6 | 63 | 66 500             | 140 000  | 6 800   | 14 200   | 4 800           | 7 500  | RNAO-55× 72×40ZW |  |
|                     |                      | 75  | 46               | 1   | 68 | 76 000             | 170 000  | 7 750   | 17 400   | 4 400           | 6 500  | RNAO-60× 75×46ZW |  |
| 60                  | $+0.049$<br>$+0.030$ | 78  | 20               | 1   | 68 | 40 000             | 75 000   | 4 100   | 7 650    | 4 400           | 6 500  | RNAO-60× 78×20   |  |
|                     |                      | 78  | 40               | 1   | 68 | 69 000             | 150 000  | 7 050   | 15 300   | 4 400           | 6 500  | RNAO-60× 78×40ZW |  |
|                     |                      | 85  | 30               | 1   | 73 | 61 000             | 132 000  | 6 200   | 13 400   | 4 100           | 6 000  | RNAO-65× 85×30   |  |
| 65                  | $+0.049$<br>$+0.030$ | 85  | 60               | 1   | 73 | 104 000            | 263 000  | 10 600  | 26 800   | 4 100           | 6 000  | RNAO-65× 85×60ZW |  |
|                     |                      | 90  | 30               | 1   | 78 | 65 500             | 149 000  | 6 700   | 15 200   | 3 800           | 5 500  | RNAO-70× 90×30   |  |
| 70                  | $+0.049$<br>$+0.030$ | 90  | 60               | 1   | 78 | 112 000            | 297 000  | 11 500  | 30 500   | 3 800           | 5 500  | RNAO-70× 90×60ZW |  |
|                     |                      | 95  | 30               | 1   | 83 | 67 500             | 157 000  | 6 850   | 16 100   | 3 600           | 5 500  | RNAO-75× 95×30   |  |
| 75                  | $+0.049$<br>$+0.030$ | 95  | 60               | 1   | 83 | 115 000            | 315 000  | 11 800  | 32 000   | 3 600           | 5 500  | RNAO-75× 95×60ZW |  |
|                     |                      | 95  | 30               | 1   | 86 | 57 000             | 159 000  | 5 800   | 16 200   | 3 300           | 5 000  | RNAO-80× 95×30   |  |
| 80                  | $+0.049$<br>$+0.030$ | 95  | 56               | 1   | 88 | 105 000            | 284 000  | 10 700  | 29 000   | 3 300           | 5 000  | RNAO-80× 95×56ZW |  |
|                     |                      | 100 | 30               | 1   | 88 | 69 000             | 166 000  | 7 050   | 17 000   | 3 300           | 5 000  | RNAO-80×100×30   |  |
|                     |                      | 100 | 60               | 1   | 88 | 119 000            | 335 000  | 12 100  | 34 000   | 3 300           | 5 000  | RNAO-80×100×60ZW |  |
|                     |                      | 105 | 25               | 1   | 93 | 61 500             | 146 000  | 6 250   | 14 900   | 3 100           | 4 700  | RNAO-85×105×25   |  |
| 85                  | $+0.058$<br>$+0.036$ |     |                  |     |    |                    |          |         |          |                 |        |                  |  |

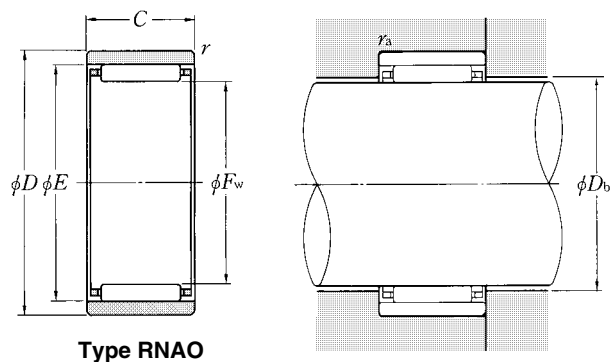
Note 1) Allowable minimum chamfer dimension  $r$ .



| $d_b$ | Abutment dimensions |       |                 | Mass<br>kg<br>(approx.) |
|-------|---------------------|-------|-----------------|-------------------------|
|       | $D_a$<br>max        | $D_b$ | $r_{as}$<br>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

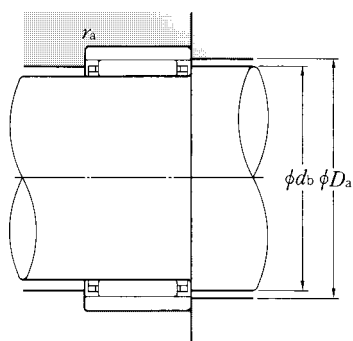


Type RNAO

 $F_w$  85~100mm

| Boundary dimensions |                                     |       |                         |     |     | Basic load ratings |         |         |        | Limiting speeds |       | Bearing numbers |
|---------------------|-------------------------------------|-------|-------------------------|-----|-----|--------------------|---------|---------|--------|-----------------|-------|-----------------|
| mm                  |                                     |       |                         |     |     | dynamic            | static  | dynamic | static | r/min           |       |                 |
| $F_w$               | $D$                                 | $C$   | $r_s$ min <sup>1)</sup> | $E$ |     | N                  |         | kgf     |        | grease          | oil   |                 |
| $C_r$               | $C_{or}$                            | $C_r$ | $C_{or}$                |     |     |                    |         |         |        |                 |       |                 |
| 85                  | <sup>+0.058</sup> <sub>+0.036</sub> | 105   | 30                      | 1   | 93  | 71 000             | 175 000 | 7 200   | 17 900 | 3 100           | 4 700 | RNAO- 85×105×30 |
| 90                  | <sup>+0.058</sup> <sub>+0.036</sub> | 105   | 26                      | 1   | 98  | 64 000             | 157 000 | 6 550   | 16 000 | 3 000           | 4 400 | RNAO- 90×105×26 |
|                     |                                     | 110   | 30                      | 1   | 98  | 72 500             | 184 000 | 7 400   | 18 800 | 3 000           | 4 400 | RNAO- 90×110×30 |
| 95                  | <sup>+0.058</sup> <sub>+0.036</sub> | 115   | 30                      | 1   | 103 | 74 000             | 193 000 | 7 550   | 19 600 | 2 800           | 4 200 | RNAO- 95×115×30 |
| 100                 | <sup>+0.058</sup> <sub>+0.035</sub> | 120   | 30                      | 1   | 108 | 76 000             | 201 000 | 7 700   | 20 500 | 2 700           | 4 000 | RNAO-100×120×30 |

Note 1) Allowable minimum chamfer dimension  $r'$ .

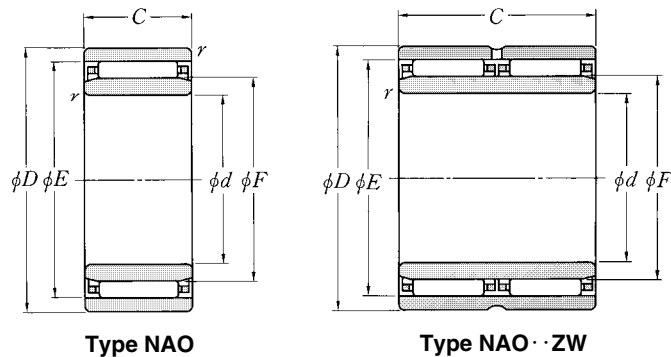


| $d_b$ | Abutment dimensions<br>mm |       |                 | Mass<br>kg<br>(approx.) |
|-------|---------------------------|-------|-----------------|-------------------------|
|       | $D_a$<br>max              | $D_b$ | $r_{as}$<br>max |                         |
| 92.2  | 100                       | 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



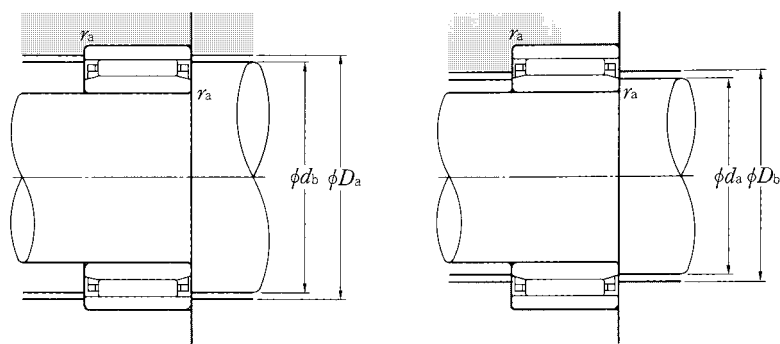
Type NAO

Type NAO · · ZW

$d$  6~30mm

| Boundary dimensions |          |          |                              |          |          | Basic load ratings   |                       |                      |                       | Limiting speeds              |        | Bearing numbers |
|---------------------|----------|----------|------------------------------|----------|----------|----------------------|-----------------------|----------------------|-----------------------|------------------------------|--------|-----------------|
| mm                  |          |          |                              |          |          | dynamic              | static                | dynamic              | static                | r/min<br>grease          oil |        |                 |
| <i>d</i>            | <i>D</i> | <i>C</i> | <i>r</i> s min <sup>-1</sup> | <i>F</i> | <i>E</i> | <i>C<sub>r</sub></i> | <i>C<sub>or</sub></i> | <i>C<sub>r</sub></i> | <i>C<sub>or</sub></i> |                              |        |                 |
| 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  $r$ .

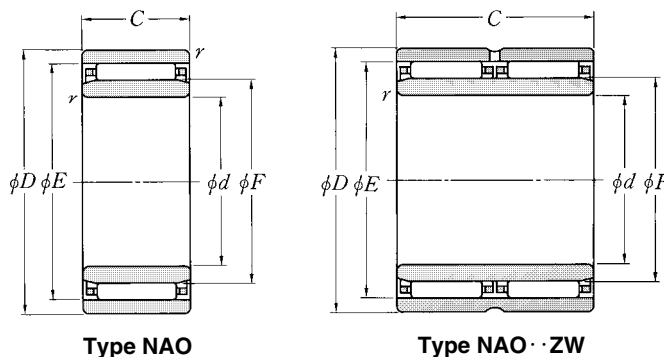


| Abutment dimensions<br>mm |       |              |       |                 | Mass<br>kg<br>(approx.) |
|---------------------------|-------|--------------|-------|-----------------|-------------------------|
| $d_a$<br>min              | $d_b$ | $D_a$<br>max | $D_b$ | $r_{as}$<br>max |                         |
| 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



Type NAO

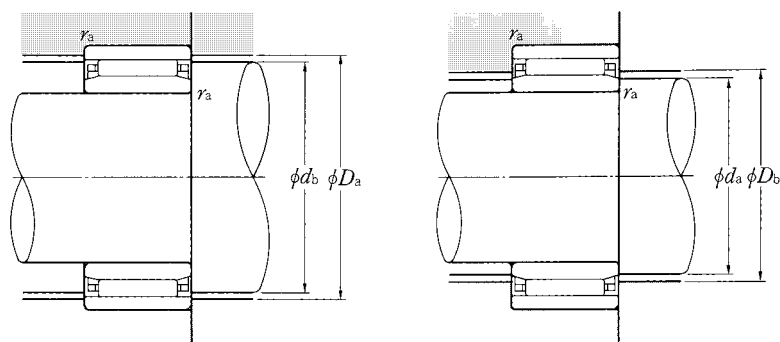
Type NAO··ZW

$d$  30~65mm

| Boundary dimensions |          |          |                               |          |          | Basic load ratings   |                       |                      |                       | Limiting speeds |        | Bearing numbers |
|---------------------|----------|----------|-------------------------------|----------|----------|----------------------|-----------------------|----------------------|-----------------------|-----------------|--------|-----------------|
| mm                  |          |          |                               |          |          | dynamic              | static                | dynamic              | static                | r/min           |        |                 |
|                     |          |          |                               |          |          | N                    |                       | kgf                  |                       | grease          | oil    |                 |
| <i>d</i>            | <i>D</i> | <i>C</i> | <i>r</i> 's min <sup>1)</sup> | <i>F</i> | <i>E</i> | <i>C<sub>r</sub></i> | <i>C<sub>or</sub></i> | <i>C<sub>r</sub></i> | <i>C<sub>or</sub></i> |                 |        |                 |
| 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  $r'$ .



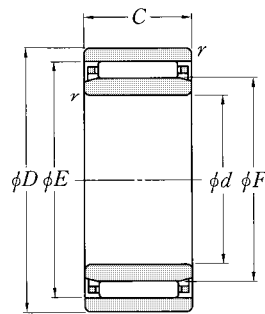


| Abutment dimensions<br>mm |       |              |       |                 | Mass<br>kg<br>(approx.) |
|---------------------------|-------|--------------|-------|-----------------|-------------------------|
| $d_a$<br>min              | $d_b$ | $D_a$<br>max | $D_b$ | $r_{as}$<br>max |                         |
| 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                    |

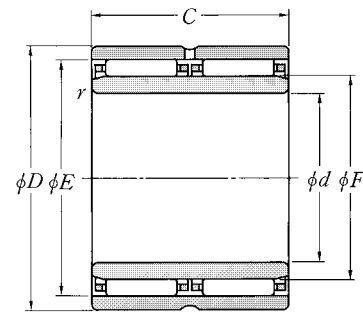
## With inner ring

## Type NAO

## Type NAO··ZW



Type NAO

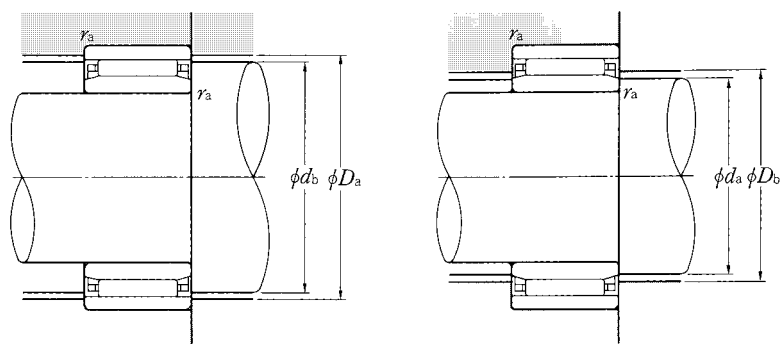


Type NAO··ZW

$d$  70~90mm

| Boundary dimensions |     |     |                        |     |     | Basic load ratings |          |         |          | Limiting speeds |       | Bearing numbers |
|---------------------|-----|-----|------------------------|-----|-----|--------------------|----------|---------|----------|-----------------|-------|-----------------|
| mm                  |     |     |                        |     |     | dynamic            | static   | dynamic | static   | r/min           |       |                 |
| $d$                 | $D$ | $C$ | $r\text{'s min}^{-1})$ | $F$ | $E$ | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ | grease          | oil   |                 |
| 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   |

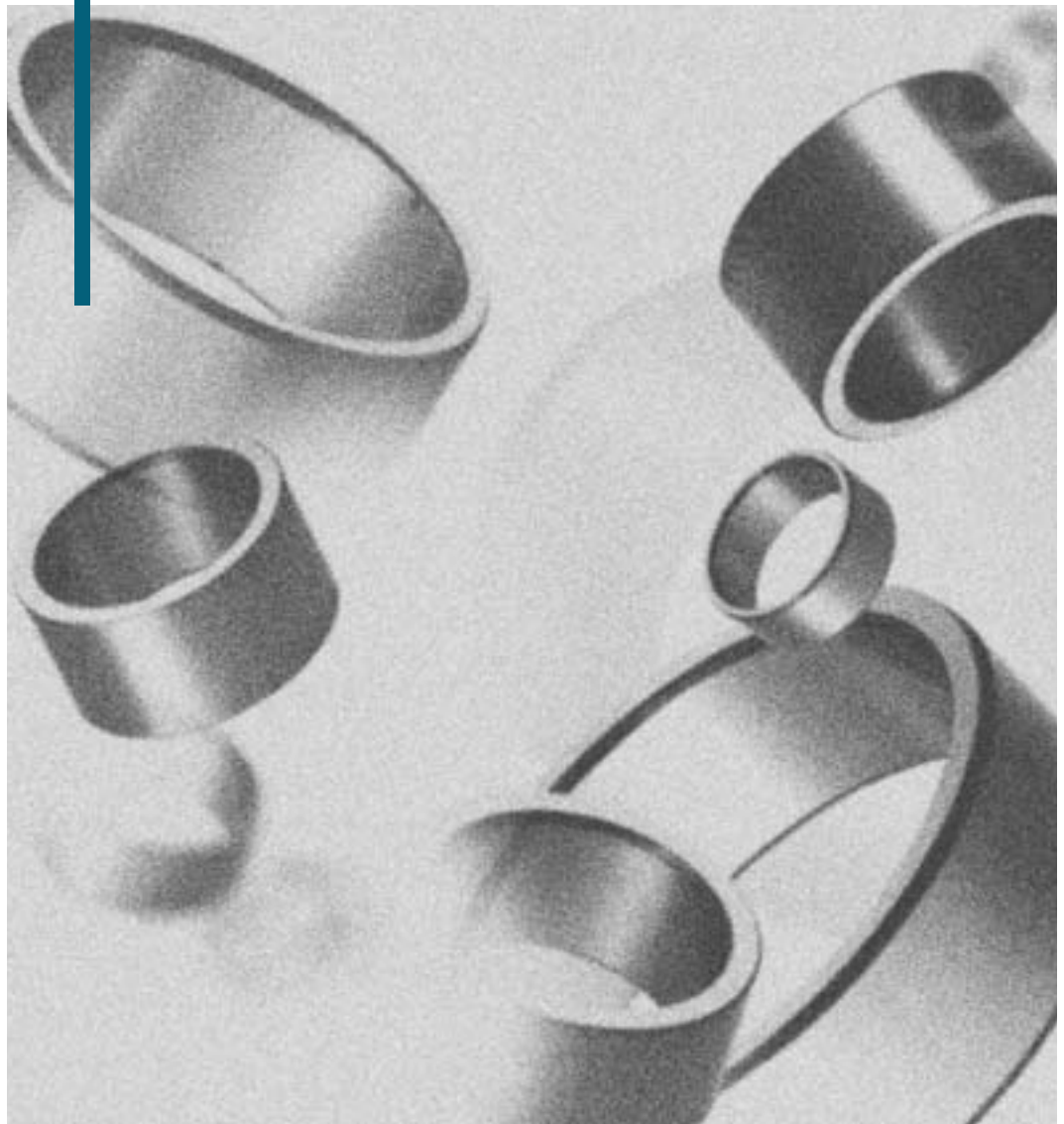
Note 1) Allowable minimum chamfer dimension  $r$ .



| Abutment dimensions<br>mm |       |              |       |                 | Mass<br>kg<br>(approx.) |
|---------------------------|-------|--------------|-------|-----------------|-------------------------|
| $d_a$<br>min              | $d_b$ | $D_a$<br>max | $D_b$ | $r_{as}$<br>max |                         |
| 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                    |



## 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. The both ends of inner ring raceway are chamfered in taper form to facilitate fitting of the inner ring. On the other hand, any inner rings with an asterisk ※-mark are fine-chamfered so as to allow greater axial displacement. In addition to these inner rings, manufacture of special inner ring type (with tail code: **D**) with oil hole on its center is also available.

Particularly where high running accuracy is required, on occasion the raceway surface of inner ring is finished by grinding after fitted on a shaft. In such a case, an inner ring with grinding allowance for its raceway can be supplied. Feel free to contact **NTN** for the detail of such an inner ring.

### Composition of nominal number

Nominal number comprises type code (**IR** or **MI**), dimension code [bore dia. ( $d$ )  $\times$  raceway dia. ( $F$ )  $\times$  width ( $B$ )] and tail code.

The dimension of inch series **MI** type is expressed at the unit of 1/16 inch.

### 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.

For the dimensional tolerance for raceway diameter ( $F$ ) shown in applicable Dimension Table, the inner ring is finished so the radial clearance comes to ordinary clearance (refer to **Table 5.1** of 5.2 "**Running clearance**" (page A-30) when it is combined with needle rollers.

Feel free to contact **NTN** for use of an inner ring subjected to radial clearance other than ordinary clearance.

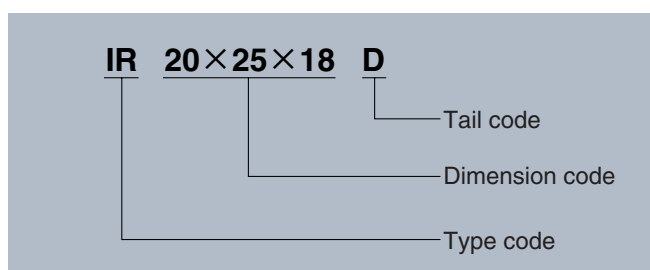
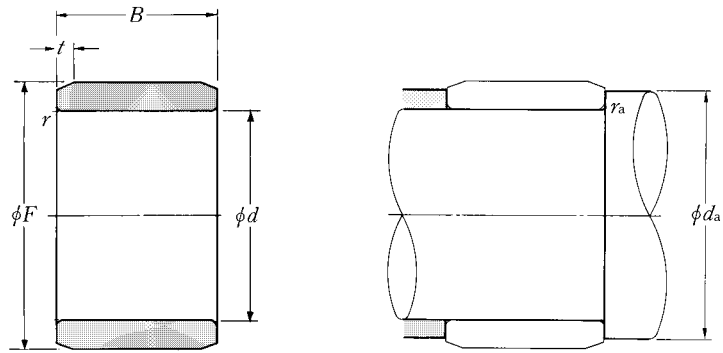


Fig. 1

## Type IR



$d$  5~10mm

| Boundary dimensions |                                    |      |                 |     | Bearing numbers | Abutment dimensions |                 | Mass      |
|---------------------|------------------------------------|------|-----------------|-----|-----------------|---------------------|-----------------|-----------|
| mm                  |                                    |      |                 |     |                 | mm                  |                 | kg        |
| $d$                 | $F^{1)}$                           | $B$  | $r's\ min^{2)}$ | $t$ |                 | $d_a$<br>min        | $r_{as}$<br>max | (approx.) |
| 5                   | 7                                  | 10   | 0.15            | 1   | IR 5× 7×10      | 6.2                 | 0.15            | 0.0014    |
|                     | 8 <sup>0</sup> <sub>−0.006</sub>   | 12   | 0.3             | 1   | IR 5× 8×12      | 7                   | 0.3             | 0.0028    |
|                     | 8                                  | 16   | 0.3             | —   | ※IR 5× 8×16     | 7                   | 0.3             | 0.0038    |
| 6                   | 8                                  | 10   | 0.15            | 1   | IR 6× 8×10      | 7.2                 | 0.15            | 0.0017    |
|                     | 9                                  | 12   | 0.3             | 1   | IR 6× 9×12      | 8                   | 0.3             | 0.0032    |
|                     | 9 <sup>0</sup> <sub>−0.006</sub>   | 16   | 0.3             | 1   | IR 6× 9×16      | 8                   | 0.3             | 0.0043    |
|                     | 10 <sup>0</sup> <sub>−0.006</sub>  | 10   | 0.3             | 1   | IR 6×10×10      | 8                   | 0.3             | 0.0037    |
|                     | 10                                 | 12   | 0.3             | —   | ※IR 6×10×12D    | 8                   | 0.3             | 0.0046    |
|                     | 10                                 | 13   | 0.3             | 1   | IR 6×10×13      | 8                   | 0.3             | 0.0050    |
| 7                   | 9                                  | 10   | 0.15            | 1   | IR 7× 9×10      | 8.2                 | 0.15            | 0.0019    |
|                     | 10 <sup>0</sup> <sub>−0.006</sub>  | 10.5 | 0.3             | 1   | IR 7×10×10.5    | 9                   | 0.3             | 0.0031    |
|                     | 10 <sup>0</sup> <sub>−0.006</sub>  | 12   | 0.3             | 1   | IR 7×10×12      | 9                   | 0.3             | 0.0036    |
|                     | 10 <sup>0</sup> <sub>−0.006</sub>  | 16   | 0.3             | 1   | IR 7×10×16      | 9                   | 0.3             | 0.0049    |
|                     | 12 <sup>−0</sup> <sub>−0.008</sub> | 16   | 0.3             | 1   | IR 7×12×16      | 9                   | 0.3             | 0.0093    |
| 8                   | 10 <sup>0</sup> <sub>−0.006</sub>  | 11   | 0.15            | 1   | IR 8×10×11      | 9.2                 | 0.15            | 0.0024    |
|                     | 12 <sup>0</sup> <sub>−0.006</sub>  | 10   | 0.3             | 1   | IR 8×12×10      | 10                  | 0.3             | 0.0048    |
|                     | 12 <sup>0</sup> <sub>−0.006</sub>  | 10.5 | 0.3             | 1   | IR 8×12×10.5    | 10                  | 0.3             | 0.0050    |
|                     | 12 <sup>0</sup> <sub>−0.008</sub>  | 12   | 0.3             | —   | ※IR 8×12×12D    | 10                  | 0.3             | 0.0057    |
|                     | 12 <sup>0</sup> <sub>−0.008</sub>  | 12.5 | 0.3             | 1   | IR 8×12×12.5    | 10                  | 0.3             | 0.0059    |
|                     | 14                                 | 16   | 0.3             | 1   | IR 8×14×16      | 10                  | 0.3             | 0.013     |
| 9                   | 12                                 | 11   | 0.3             | 1   | IR 9×12×11      | 11                  | 0.3             | 0.0041    |
|                     | 12 <sup>0</sup> <sub>−0.008</sub>  | 12   | 0.3             | 1   | IR 9×12×12      | 11                  | 0.3             | 0.0045    |
|                     | 12 <sup>0</sup> <sub>−0.008</sub>  | 16   | 0.3             | 1   | IR 9×12×16      | 11                  | 0.3             | 0.0061    |
|                     | 15                                 | 16   | 0.3             | 1   | IR 9×15×16      | 11                  | 0.3             | 0.014     |
| 10                  | 13                                 | 12.5 | 0.3             | 1   | IR10×13×12.5    | 12                  | 0.3             | 0.0052    |
|                     | 14                                 | 12   | 0.3             | 1   | IR10×14×12      | 12                  | 0.3             | 0.0073    |
|                     | 14 <sup>0</sup> <sub>−0.008</sub>  | 13   | 0.3             | 1   | IR10×14×13      | 12                  | 0.3             | 0.0074    |
|                     | 14 <sup>0</sup> <sub>−0.008</sub>  | 14   | 0.3             | —   | ※IR10×14×14D    | 12                  | 0.3             | 0.0080    |
|                     | 14                                 | 16   | 0.3             | —   | ※IR10×14×16     | 12                  | 0.3             | 0.0092    |
|                     | 14                                 | 20   | 0.3             | 1   | IR10×14×20      | 12                  | 0.3             | 0.012     |

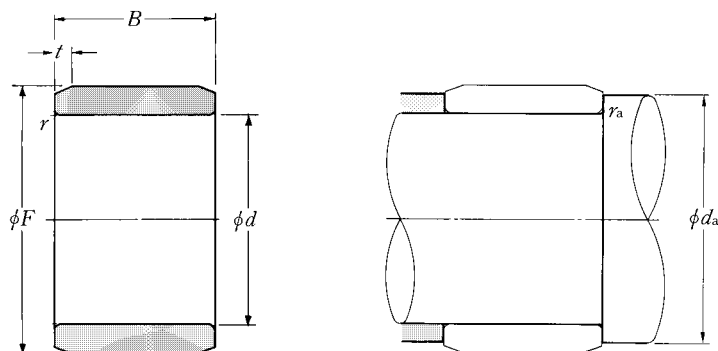
Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.

2) Allowable minimum chamfer dimension  $r$ .

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      |
|---------------------|-----------------------------------|------|------------------|-----|-----------------|---------------------|-----------------|-----------|
| mm                  |                                   |      |                  |     |                 | mm                  |                 | kg        |
| $d$                 | $F^{1)}$                          | $B$  | $r_{s\min}^{2)}$ | $t$ |                 | $d_a$<br>min        | $r_{as}$<br>max | (approx.) |
| 10                  | 15                                | 15.5 | 0.3              | 1   | IR10×15×15.5    | 12                  | 0.3             | 0.012     |
|                     | 15 <sup>0</sup> <sub>−0.008</sub> | 20.5 | 0.3              | 1   | IR10×15×20.5    | 12                  | 0.3             | 0.015     |
|                     | 16                                | 16   | 0.3              | 1   | IR10×16×16      | 12                  | 0.3             | 0.015     |
| 12                  | 15                                | 12   | 0.3              | 1   | IR12×15×12      | 14                  | 0.3             | 0.0058    |
|                     | 15                                | 12.5 | 0.3              | 1   | IR12×15×12.5    | 14                  | 0.3             | 0.0061    |
|                     | 15                                | 16   | 0.3              | 1   | IR12×15×16      | 14                  | 0.3             | 0.0078    |
|                     | 15                                | 16.5 | 0.3              | —   | ※IR12×15×16.5   | 14                  | 0.3             | 0.0080    |
|                     | 15                                | 22.5 | 0.3              | —   | ※IR12×15×22.5   | 14                  | 0.3             | 0.011     |
|                     | 16                                | 12   | 0.3              | 1.5 | IR12×16×12      | 14                  | 0.3             | 0.0079    |
|                     | 16 <sup>0</sup> <sub>−0.008</sub> | 13   | 0.3              | 1.5 | IR12×16×13      | 14                  | 0.3             | 0.0087    |
|                     | 16                                | 14   | 0.3              | —   | ※IR12×16×14D    | 14                  | 0.3             | 0.0095    |
|                     | 16                                | 16   | 0.3              | 1.5 | IR12×16×16      | 14                  | 0.3             | 0.011     |
|                     | 16                                | 20   | 0.3              | 1.5 | IR12×16×20      | 14                  | 0.3             | 0.014     |
|                     | 16                                | 22   | 0.3              | 1.5 | IR12×16×22      | 14                  | 0.3             | 0.015     |
|                     | 17                                | 20.5 | 0.3              | 1.5 | IR12×17×20.5    | 14                  | 0.3             | 0.019     |
|                     | 17                                | 25.5 | 0.3              | 1.5 | IR12×17×25.5    | 14                  | 0.3             | 0.024     |
|                     | 18                                | 16   | 0.3              | 1.5 | IR12×18×16      | 14                  | 0.3             | 0.018     |
| 14                  | 17 <sup>0</sup> <sub>−0.008</sub> | 17   | 0.3              | 1.5 | IR14×17×17      | 16                  | 0.3             | 0.0095    |
| 15                  | 18                                | 12.5 | 0.3              | 1.5 | IR15×18×12.5    | 17                  | 0.3             | 0.0072    |
|                     | 18                                | 16   | 0.3              | 1.5 | IR15×18×16      | 17                  | 0.3             | 0.0093    |
|                     | 18 <sup>0</sup> <sub>−0.008</sub> | 16.5 | 0.3              | 1.5 | IR15×18×16.5    | 17                  | 0.3             | 0.0096    |
|                     | 18                                | 17.5 | 0.3              | 1.5 | IR15×18×17.5    | 17                  | 0.3             | 0.010     |
|                     | 18                                | 20.5 | 0.3              | 1.5 | IR15×18×20.5    | 17                  | 0.3             | 0.012     |
|                     | 18                                | 25.5 | 0.3              | 1.5 | IR15×18×25.5    | 17                  | 0.3             | 0.015     |
|                     | 19                                | 16   | 0.3              | 1.5 | IR15×19×16      | 17                  | 0.3             | 0.013     |
|                     | 19                                | 20   | 0.3              | 1.5 | IR15×19×20      | 17                  | 0.3             | 0.016     |
|                     | 20                                | 12   | 0.3              | 1.5 | IR15×20×12      | 17                  | 0.3             | 0.012     |
|                     | 20 <sup>0</sup> <sub>−0.009</sub> | 13   | 0.3              | 1.5 | IR15×20×13      | 17                  | 0.3             | 0.014     |
|                     | 20                                | 14   | 0.3              | —   | ※IR15×20×14D    | 17                  | 0.3             | 0.015     |
|                     | 20                                | 18   | 0.3              | 1.5 | IR15×20×18      | 17                  | 0.3             | 0.019     |
|                     | 20                                | 20.5 | 0.3              | 1.5 | IR15×20×20.5    | 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  $r$ .

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<br>kg<br>(approx.) |
|---------------------|----------------------|------|-----------------|-----|-----------------|---------------------|-----------------|-------------------------|
| $d$                 | $r^{1)}$             | $B$  | $r's \min^{2)}$ | $t$ |                 | $d_a$<br>min        | $r_{as}$<br>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 <sub>-0.009</sub> | 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 <sub>-0.009</sub> | 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 <sub>-0.009</sub> | 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                   |

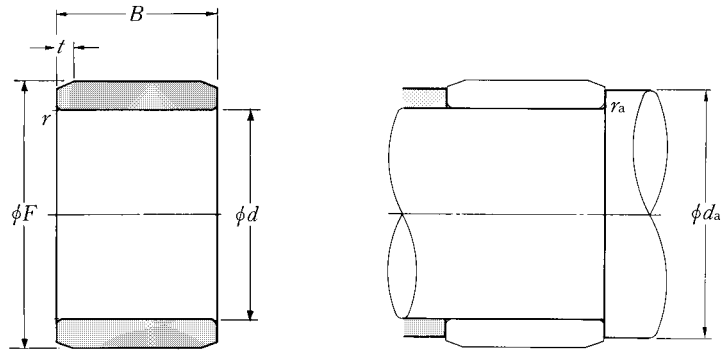
Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.

2) Allowable minimum chamfer dimension  $r$ .

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<br>kg<br>(approx.) |
|---------------------|----------------------------------------|------|-------------------|-----|-----------------|---------------------|-----------------|-------------------------|
| $d$                 | $F^{1)}$                               | $B$  | $r_{s \min}^{2)}$ | $t$ |                 | $d_a$<br>min        | $r_{as}$<br>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                                     | 30   | 0.3               | 1.8 | IR20×25×30      | 22                  | 0.3             | 0.041                   |
|                     | 25 <sub>-0.009</sub> <sup>0</sup>      | 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>-0.009</sub> <sup>0</sup>      | 20   | 0.3               | 1.8 | IR22×28×20      | 24                  | 0.3             | 0.035                   |
|                     | 28                                     | 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>-0.009</sub> <sup>0</sup>      | 20   | 0.3               | 1.8 | IR25×30×20      | 27                  | 0.3             | 0.033                   |
|                     | 30                                     | 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>-0.002</sub> <sup>+0.008</sup> | 22   | 0.6               | 1.8 | IR25×32×22      | 29                  | 0.6             | 0.052                   |
|                     | 32                                     | 30.5 | 0.6               | 1.8 | IR25×32×30.5    | 29                  | 0.6             | 0.072                   |
| 28                  | 32 <sub>-0.002</sub> <sup>-0.008</sup> | 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  $r$ .

Remarks: 1. Nominal number plus ※-mark represents inner ring with fine-chamfered outer surface.

$d$  28~35mm

| Boundary dimensions |                                   |      |                  |     | Bearing numbers | Abutment dimensions |                 | Mass      |
|---------------------|-----------------------------------|------|------------------|-----|-----------------|---------------------|-----------------|-----------|
| mm                  |                                   |      |                  |     |                 | mm                  |                 | kg        |
| $d$                 | $F^{1)}$                          | $B$  | $r_{s\min}^{2)}$ | $t$ |                 | $d_a$<br>min        | $r_{as}$<br>max | (approx.) |
| 28                  | 32                                | 20   | 0.3              | 1.8 | IR28×32×20      | 30                  | 0.3             | 0.028     |
|                     | 32 <sup>+0.008<br/>-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<br/>-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<br/>-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> <sup>-0.011</sup> | 32   | 0.3              | 2   | IR32×38×32      | 34                  | 0.3             | 0.082     |
|                     | 40                                | 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     |

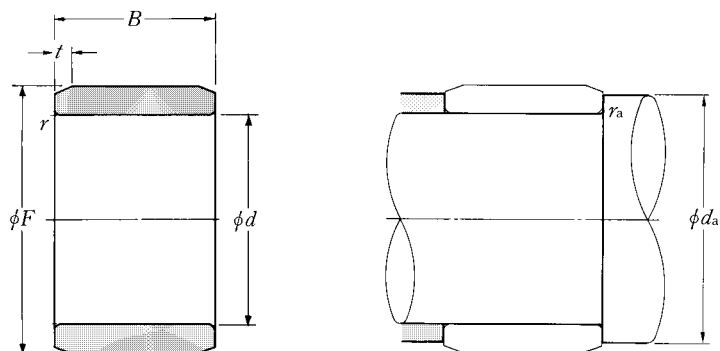
Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.

2) Allowable minimum chamfer dimension  $r$ .

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      |
|---------------------|----------------------------|------|------------------|-----|-----------------|---------------------|-----------------|-----------|
| mm                  |                            |      |                  |     |                 | mm                  |                 | kg        |
| $d$                 | $F^{1)}$                   | $B$  | $r_{s\min}^{2)}$ | $t$ |                 | $d_a$<br>min        | $r_{as}$<br>max | (approx.) |
| 35                  | 40                         | 20.5 | 0.3              | 2   | IR35×40×20.5    | 37                  | 0.3             | 0.046     |
|                     | 40                         | 30   | 0.3              | —   | ※IR35×40×30     | 37                  | 0.3             | 0.068     |
|                     | 40                         | 34   | 0.3              | 1.8 | IR35×40×34      | 37                  | 0.3             | 0.079     |
|                     | 40                         | 40   | 0.3              | 2   | IR35×40×40      | 37                  | 0.3             | 0.091     |
|                     | 42 <sub>0<br/>-0.011</sub> | 20   | 0.6              | 1.8 | IR35×42×20      | 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   | IR35×42×27      | 39                  | 0.6             | 0.080     |
|                     | 42                         | 36   | 0.6              | 2   | IR35×42×36      | 39                  | 0.6             | 0.117     |
|                     | 43                         | 22   | 0.6              | 2   | IR35×43×22      | 39                  | 0.6             | 0.081     |
| 38                  | 43 <sub>0<br/>-0.011</sub> | 20   | 0.3              | 1.8 | IR38×43×20      | 40                  | 0.3             | 0.048     |
|                     | 43                         | 30   | 0.3              | —   | ※IR38×43×30     | 40                  | 0.3             | 0.074     |
| 40                  | 45                         | 16.5 | 0.3              | 2   | IR40×45×16.5    | 42                  | 0.3             | 0.042     |
|                     | 45                         | 17   | 0.3              | 2   | IR40×45×17      | 42                  | 0.3             | 0.043     |
|                     | 45                         | 20   | 0.3              | 2   | IR40×45×20      | 42                  | 0.3             | 0.051     |
|                     | 45                         | 20.5 | 0.3              | 2   | IR40×45×20.5    | 42                  | 0.3             | 0.053     |
|                     | 45                         | 26.5 | 0.3              | —   | ※IR40×45×26.5   | 42                  | 0.3             | 0.068     |
|                     | 45                         | 30   | 0.3              | 2   | IR40×45×30      | 42                  | 0.3             | 0.077     |
|                     | 45 <sub>0<br/>-0.011</sub> | 34   | 0.3              | 2   | IR40×45×34      | 42                  | 0.3             | 0.088     |
|                     | 45                         | 40   | 0.3              | 2   | IR40×45×40      | 42                  | 0.3             | 0.106     |
|                     | 48                         | 22   | 0.6              | 2   | IR40×48×22      | 44                  | 0.6             | 0.092     |
|                     | 48                         | 23   | 0.6              | —   | ※IR40×48×23     | 44                  | 0.6             | 0.097     |
|                     | 48                         | 30   | 0.6              | 2   | IR40×48×30      | 44                  | 0.6             | 0.123     |
|                     | 48                         | 40   | 0.6              | 2   | IR40×48×40      | 44                  | 0.6             | 0.170     |
|                     | 50                         | 20   | 0.3              | 0.8 | IR40×50×20      | 44                  | 0.3             | 0.106     |
|                     | 50                         | 22   | 1                | 2   | IR40×50×22      | 45                  | 1               | 0.118     |
| 42                  | 47 <sub>0<br/>-0.011</sub> | 20   | 0.3              | 2   | IR42×47×20      | 44                  | 0.3             | 0.053     |
|                     | 47                         | 30   | 0.3              | 2   | IR42×47×30      | 44                  | 0.3             | 0.080     |
| 45                  | 50 <sub>0<br/>-0.011</sub> | 20   | 0.3              | 2   | IR45×50×20      | 47                  | 0.3             | 0.057     |
|                     | 50                         | 25   | 0.6              | 2   | IR45×50×25      | 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  $r$ .

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<br>kg<br>(approx.) |
|---------------------|--------------------------------|------|------------------------|-----|-----------------|---------------------|-----------------|-------------------------|
| $d$                 | $r^{1)}$                       | $B$  | $r_s \text{ min}^{2)}$ | $t$ |                 | $d_a$<br>min        | $r_{as}$<br>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><br>-0.011      | 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><br>-0.004 | 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><br>-0.004 | 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><br>-0.013      | 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                   |

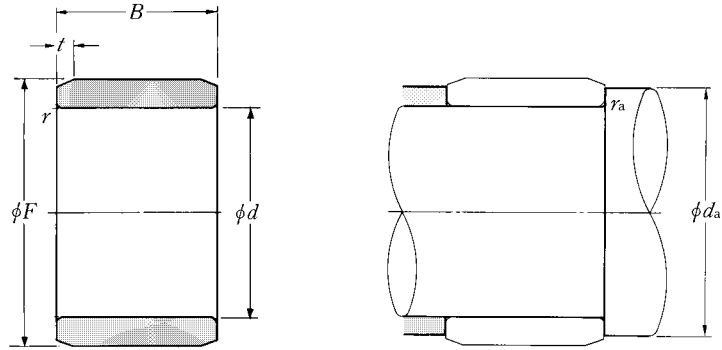
Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.

2) Allowable minimum chamfer dimension  $r$ .

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      |
|---------------------|-----------------------------------|-----|-----------------|-----|-----------------|---------------------|-----------------|-----------|
| mm                  |                                   |     |                 |     |                 | mm                  |                 | kg        |
| $d$                 | $F^{1)}$                          | $B$ | $r's\ min^{2)}$ | $t$ |                 | $d_a$<br>min        | $r_{as}$<br>max | (approx.) |
| 60                  | 68                                | 25  | 1               | 2.2 | IR60×68×25      | 65                  | 1               | 0.152     |
|                     | 68                                | 34  | 1               | 2.2 |                 | 65                  | 1               | 0.206     |
|                     | 68                                | 35  | 0.6             | 2.2 |                 | 64                  | 0.6             | 0.213     |
|                     | 68 <sup>0</sup> <sub>−0.013</sub> | 45  | 1               | 2.2 |                 | 65                  | 1               | 0.270     |
|                     | 70                                | 25  | 1               | 2.2 |                 | 65                  | 1               | 0.195     |
|                     | 70                                | 28  | 1.1             | 2.2 |                 | 66.5                | 1               | 0.216     |
|                     | 70                                | 30  | 1               | 2.2 |                 | 65                  | 1               | 0.232     |
|                     | 70                                | 60  | 1               | 2.2 |                 | IR60×70×60          | 65              | 1         |
| 65                  | 72                                | 25  | 1               | 2.2 | IR65×72×25      | 70                  | 1               | 0.142     |
|                     | 72                                | 34  | 1               | 2.2 |                 | 70                  | 1               | 0.193     |
|                     | 72                                | 45  | 1               | 2.2 |                 | 70                  | 1               | 0.259     |
|                     | 73 <sup>0</sup> <sub>−0.013</sub> | 25  | 0.6             | 2.2 |                 | 69                  | 0.6             | 0.164     |
|                     | 73                                | 35  | 0.6             | 2.2 |                 | 69                  | 0.6             | 0.232     |
|                     | 75                                | 28  | 1.1             | 2.2 |                 | 71.5                | 1               | 0.240     |
|                     | 75                                | 30  | 1               | 2.2 |                 | 70                  | 1               | 0.256     |
|                     | 75                                | 60  | 1               | 2.2 |                 | IR65×75×60          | 70              | 1         |
| 70                  | 80                                | 25  | 1               | 2.2 | IR70×80×25      | 75                  | 1               | 0.224     |
|                     | 80                                | 28  | 1.1             | 2.2 |                 | 76.5                | 1               | 0.250     |
|                     | 80                                | 30  | 1               | 2.2 |                 | 75                  | 1               | 0.267     |
|                     | 80 <sup>0</sup> <sub>−0.013</sub> | 35  | 1               | 2.2 |                 | 75                  | 1               | 0.313     |
|                     | 80                                | 40  | 1               | 2.2 |                 | 75                  | 1               | 0.358     |
|                     | 80                                | 54  | 1               | 2.2 |                 | 75                  | 1               | 0.483     |
|                     | 80                                | 56  | 1               | 2.2 |                 | 75                  | 1               | 0.502     |
|                     | 80                                | 60  | 1               | 2.2 |                 | IR70×80×60          | 75              | 1         |
| 75                  | 85                                | 25  | 1               | 2.2 | IR75×85×25      | 80                  | 1               | 0.238     |
|                     | 85                                | 30  | 1               | 2.2 |                 | 80                  | 1               | 0.287     |
|                     | 85 <sup>0</sup> <sub>−0.015</sub> | 35  | 1               | 2.2 |                 | 80                  | 1               | 0.336     |
|                     | 85                                | 40  | 1               | 2.2 |                 | 80                  | 1               | 0.385     |
|                     | 85                                | 54  | 1               | 2.2 |                 | 80                  | 1               | 0.515     |
|                     | 90                                | 32  | 1.1             | 2.2 |                 | IR75×90×32          | 81.5            | 1         |

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'.

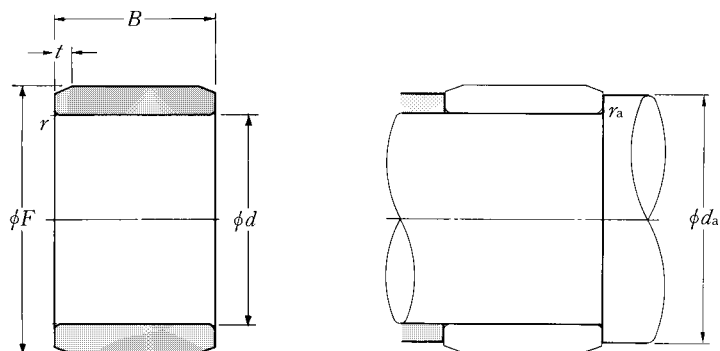
$d$  80~100mm

| Boundary dimensions |                                    |     |                        |     | Bearing numbers | Abutment dimensions |                 | Mass<br>kg<br>(approx.) |
|---------------------|------------------------------------|-----|------------------------|-----|-----------------|---------------------|-----------------|-------------------------|
| $d$                 | $F^{1)}$                           | $B$ | $r_s \text{ min}^{2)}$ | $t$ |                 | $d_a$<br>min        | $r_{as}$<br>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                                 | 35  | 1                      | 2.2 | IR 80×90×35     | 85                  | 1               | 0.355                   |
|                     | 90 <sup>0</sup> <sub>-0.015</sub>  | 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 <sup>0</sup> <sub>-0.015</sub> | 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 <sup>0</sup> <sub>-0.015</sub> | 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 <sup>0</sup> <sub>-0.015</sub> | 32  | 1.1                    | 2.5 | IR 95×110×32    | 101.5               | 1               | 0.590                   |
|                     | 110                                | 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 <sup>0</sup> <sub>-0.015</sub> | 40  | 1.1                    | 2.5 | IR100×110×40    | 106.5               | 1               | 0.505                   |
|                     | 115                                | 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  $r$ .

## Type IR



$d$  100~160mm

| Boundary dimensions |                                         |     |                  |     | Bearing numbers | Abutment dimensions |                 | Mass      |
|---------------------|-----------------------------------------|-----|------------------|-----|-----------------|---------------------|-----------------|-----------|
| mm                  |                                         |     |                  |     |                 | mm                  |                 | kg        |
| $d$                 | $F^{1)}$                                | $B$ | $r_{s\min}^{2)}$ | $t$ |                 | $d_a$<br>min        | $r_{as}$<br>max | (approx.) |
| 100                 | 115 <sup>0</sup> <sub>−0.015</sub>      | 54  | 1.1              | 2.5 | IR100×115×54    | 106.5               | 1               | 1.09      |
| 110                 | 120 <sup>0</sup> <sub>−0.015</sub>      | 30  | 1                | 2.5 | IR110×120×30    | 115                 | 1               | 0.440     |
|                     | 120 <sup>0</sup> <sub>−0.015</sub>      | 40  | 1.1              | 2.5 | IR110×120×40    | 116.5               | 1               | 0.580     |
|                     | 125 <sup>0</sup> <sub>−0.018</sub>      | 40  | 1.1              | 2.5 | IR110×125×40    | 116.5               | 1               | 0.840     |
|                     | 125 <sup>0</sup> <sub>−0.018</sub>      | 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 <sup>0</sup> <sub>−0.018</sub>      | 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 <sup>0</sup> <sub>−0.018</sub>      | 42  | 1.5              | 3   | IR130×145×42    | 138                 | 1.5             | 1.05      |
|                     | 150 <sup>0</sup> <sub>−0.018</sub>      | 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 <sup>0</sup> <sub>−0.018</sub>      | 42  | 1.5              | 3   | IR140×155×42    | 148                 | 1.5             | 1.10      |
|                     | 160 <sup>0</sup> <sub>−0.018</sub>      | 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 <sup>−0.017</sup> <sub>−0.035</sub> | 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 <sup>−0.017</sup> <sub>−0.035</sub> | 40  | 1.1              | 3   | IR160×175×40    | 166.5               | 1               | 1.20      |
|                     | 180 <sup>−0.017</sup> <sub>−0.035</sub> | 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  $r$ .



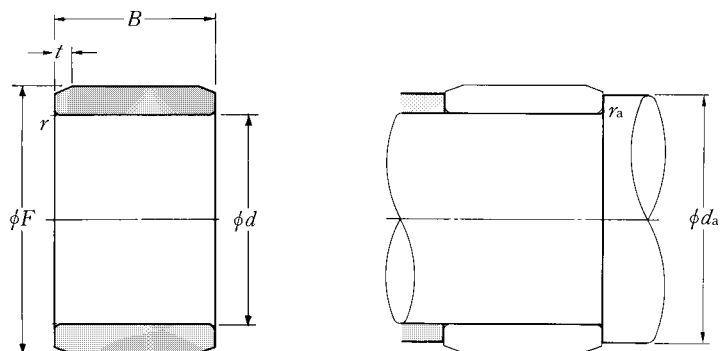
$d$  170~380mm

| Boundary dimensions |                          |     |                        |     | Bearing numbers | Abutment dimensions |                 | Mass      |
|---------------------|--------------------------|-----|------------------------|-----|-----------------|---------------------|-----------------|-----------|
| mm                  |                          |     |                        |     |                 | mm                  |                 | kg        |
| $d$                 | $F^{1)}$                 | $B$ | $r_s \text{ min}^{2)}$ | $t$ |                 | $d_a$<br>min        | $r_{as}$<br>max | (approx.) |
| 170                 | 185 $_{-0.013}^{+0.013}$ | 45  | 1.1                    | 3   | IR170×185× 45   | 176.5               | 1               | 1.45      |
|                     | 190 $_{-0.043}^{+0.043}$ | 60  | 2                      | 3   | IR170×190× 60   | 179                 | 2               | 2.65      |
| 180                 | 195 $_{-0.013}^{+0.013}$ | 45  | 1.1                    | 3   | IR180×195× 45   | 186.5               | 1               | 1.51      |
|                     | 205 $_{-0.043}^{+0.043}$ | 69  | 2                      | 3   | IR180×205× 69   | 189                 | 2               | 4.10      |
| 190                 | 210 $_{-0.020}^{+0.020}$ | 50  | 1.5                    | 3.5 | IR190×210× 50   | 198                 | 1.5             | 2.41      |
|                     | 215 $_{-0.050}^{+0.050}$ | 69  | 2                      | 3.5 | IR190×215× 69   | 199                 | 2               | 4.10      |
| 200                 | 220 $_{-0.020}^{+0.020}$ | 50  | 1.5                    | 3.5 | IR200×220× 50   | 208                 | 1.5             | 2.49      |
|                     | 225 $_{-0.050}^{+0.050}$ | 80  | 2.1                    | 3.5 | IR200×225× 80   | 211                 | 2               | 5.10      |
| 220                 | 240 $_{-0.033}^{+0.033}$ | 50  | 1.5                    | 3.5 | IR220×240× 50   | 228                 | 1.5             | 2.75      |
|                     | 245 $_{-0.063}^{+0.063}$ | 80  | 2.1                    | 3.5 | IR220×245× 80   | 231                 | 2               | 5.70      |
| 240                 | 265 $_{-0.037}^{+0.037}$ | 60  | 2                      | 3.5 | IR240×265× 60   | 249                 | 2               | 4.60      |
|                     | 265 $_{-0.069}^{+0.069}$ | 80  | 2.1                    | 3.5 | IR240×265× 80   | 251                 | 2               | 6.30      |
| 260                 | 285 $_{-0.064}^{+0.064}$ | 60  | 2                      | 4   | IR260×285× 60   | 269                 | 2               | 4.98      |
|                     | 290 $_{-0.092}^{+0.092}$ | 100 | 2.1                    | 4   | IR260×290×100   | 271                 | 2               | 10.0      |
| 280                 | 305 $_{-0.064}^{+0.064}$ | 69  | 2                      | 4   | IR280×305× 69   | 289                 | 2               | 6.20      |
|                     | 310 $_{-0.092}^{+0.092}$ | 100 | 2.1                    | 4   | IR280×310×100   | 291                 | 2               | 10.8      |
| 300                 | 330 $_{-0.062}^{+0.062}$ | 80  | 2.1                    | 4   | IR300×330× 80   | 311                 | 2               | 9.30      |
|                     | 340 $_{-0.098}^{+0.098}$ | 118 | 3                      | 4   | IR300×340×118   | 313                 | 2.5             | 18.5      |
| 320                 | 350 $_{-0.062}^{+0.062}$ | 80  | 2.1                    | 5   | IR320×350× 80   | 331                 | 2               | 9.80      |
|                     | 360 $_{-0.098}^{+0.098}$ | 118 | 3                      | 5   | IR320×360×118   | 333                 | 2.5             | 20.0      |
| 340                 | 370 $_{-0.062}^{+0.062}$ | 80  | 2.1                    | 5   | IR340×370× 80   | 351                 | 2               | 10.1      |
|                     | 380 $_{-0.098}^{+0.098}$ | 118 | 3                      | 5   | IR340×380×118   | 353                 | 2.5             | 22.0      |
| 360                 | 390 $_{-0.090}^{+0.090}$ | 80  | 2.1                    | 5   | IR360×390× 80   | 371                 | 2               | 10.9      |
|                     | 400 $_{-0.126}^{+0.126}$ | 118 | 3                      | 5   | IR360×400×118   | 373                 | 2.5             | 22.0      |
| 380                 | 415 $_{-0.080}^{+0.080}$ | 100 | 2.1                    | 5   | IR380×415×100   | 391                 | 2               | 18.5      |
|                     | 430 $_{-0.120}^{+0.120}$ | 140 | 4                      | 5   | IR380×430×140   | 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  $r$ .

## Type IR



$d$  400~440mm

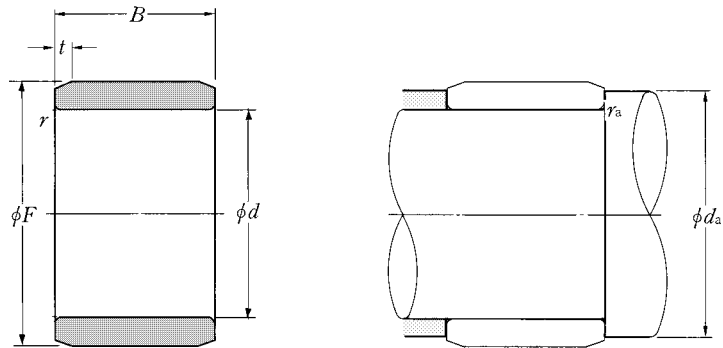
| Boundary dimensions |                         |     |                   |     | Bearing numbers | Abutment dimensions |                 | Mass<br>kg<br>(approx.) |
|---------------------|-------------------------|-----|-------------------|-----|-----------------|---------------------|-----------------|-------------------------|
| $d$                 | $F^{1)}$                | $B$ | $r_{s \min}^{2)}$ | $t$ |                 | $d_a$<br>min        | $r_{as}$<br>max |                         |
| 400                 | 450<br>-0.080<br>-0.120 | 140 | 4                 | 5   | IR400×450×140   | 416                 | 3               | 36.5                    |
| 420                 | 470<br>-0.105<br>-0.145 | 140 | 4                 | 5   | IR420×470×140   | 436                 | 3               | 38.2                    |
| 440                 | 490<br>-0.105<br>-0.145 | 160 | 4                 | 5   | IR440×490×160   | 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  $r^*$ .

## Inch series

## Type MI



$d$  9.525~34.925mm

| Boundary dimensions       |                                               |       |                  |     | Bearing numbers | Abutment dimensions |                 | Mass      |
|---------------------------|-----------------------------------------------|-------|------------------|-----|-----------------|---------------------|-----------------|-----------|
| mm ( $\frac{1}{25.4}$ mm) |                                               |       |                  |     |                 | mm                  |                 | kg        |
| $d$                       | $F^{1)}$                                      | $B$   | $r_{s\min}^{2)}$ | $t$ |                 | $d_a$<br>min        | $r_{as}$<br>max | (approx.) |
| 9.525( $\frac{3}{8}$ )    | 14.288( $\frac{9}{16}$ )                      | 12.95 | 0.6              | —   | ※MI-060908      | 13.5                | 0.6             | 0.013     |
|                           | 15.875( $\frac{5}{8}$ )<br>$0_{-0.008}$       | 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( $\frac{3}{4}$ )<br>$0_{-0.009}$       | 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( $\frac{7}{8}$ )<br>$0_{-0.009}$       | 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)<br>$0_{-0.009}$                     | 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( $1\frac{1}{8}$ )<br>$0_{-0.009}$      | 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( $1\frac{1}{4}$ )<br>$+0.008_{-0.002}$ | 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( $1\frac{3}{8}$ )<br>$+0.008_{-0.002}$ | 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( $1\frac{1}{2}$ )<br>$0_{-0.011}$      | 25.65 | 1.5              | —   | ※MI-202416      | 37                  | 1.5             | 0.075     |
|                           | 38.100( $1\frac{1}{2}$ )                      | 32.00 | 1.5              | —   | ※MI-202420      | 37                  | 1.5             | 0.094     |
| 33.338( $1\frac{5}{16}$ ) | 41.275( $1\frac{5}{8}$ )<br>$0_{-0.011}$      | 25.65 | 1.5              | 2   | MI-212616       | 40                  | 1.5             | 0.093     |
|                           | 41.275( $1\frac{5}{8}$ )                      | 32.00 | 1.5              | 2   | MI-212620       | 40                  | 1.5             | 0.116     |
| 34.925( $1\frac{3}{8}$ )  | 41.275( $1\frac{5}{8}$ )<br>$0_{-0.011}$      | 16.13 | 1.5              | 2   | MI-222610       | 40                  | 1.5             | 0.073     |
|                           | 44.450( $1\frac{3}{4}$ )                      | 25.65 | 1.5              | 2   | MI-222816       | 41.5                | 1.5             | 0.117     |

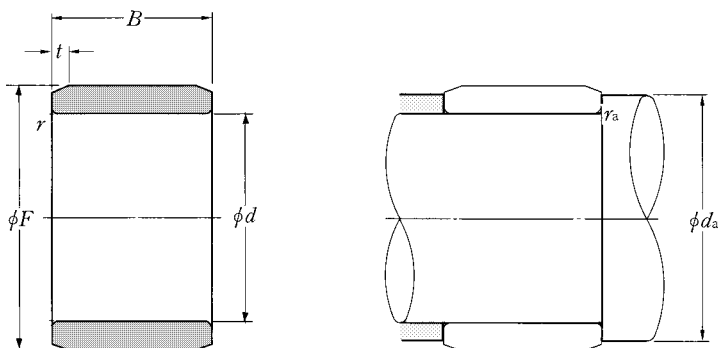
Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.

2) Allowable minimum chamfer dimension  $r$ .

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      |
|---------------------------|-----------------------------------------------|-------|-------------------|-----|--|-----------------|---------------------|-----------------|-----------|
| mm ( $\frac{1}{25.4}$ mm) |                                               |       |                   |     |  |                 | mm                  |                 | kg        |
| $d$                       | $F^{1)}$                                      | $B$   | $r_{s\ min}^{2)}$ | $t$ |  |                 | $d_a$<br>min        | $r_{as}$<br>max | (approx.) |
| 34.925(1 $\frac{3}{8}$ )  | 44.450(1 $\frac{3}{4}$ ) $_{-0.011}^0$        | 32.00 | 1.5               | 2   |  | MI-222820       | 41.5                | 1.5             | 0.146     |
| 38.100(1 $\frac{1}{2}$ )  | 44.450(1 $\frac{3}{4}$ ) $_{-0.011}^0$        | 19.30 | 1.5               | 2   |  | MI-242812       | 43                  | 1.5             | 0.062     |
|                           | 44.450(1 $\frac{3}{4}$ ) $_{-0.011}^0$        | 25.65 | 1.5               | 2   |  | MI-242816       | 43                  | 1.5             | 0.083     |
| 39.688(1 $\frac{9}{16}$ ) | 47.625(1 $\frac{7}{8}$ ) $_{-0.011}^0$        | 32.00 | 1.5               | 2   |  | MI-253020       | 46                  | 1.5             | 0.136     |
| 41.275(1 $\frac{5}{8}$ )  | 50.800(2) $_{-0.004}^{+0.008}$                | 25.65 | 1.5               | 2   |  | MI-263216       | 48                  | 1.5             | 0.140     |
|                           | 50.800(2) $_{-0.004}^{+0.008}$                | 32.00 | 1.5               | 2   |  | MI-263220       | 48                  | 1.5             | 0.175     |
| 44.450(1 $\frac{3}{4}$ )  | 57.150(2 $\frac{1}{4}$ ) $_{-0.004}^{+0.008}$ | 38.35 | 1.5               | 2   |  | MI-283624       | 51                  | 1.5             | 0.310     |
|                           | 57.150(2 $\frac{1}{4}$ ) $_{-0.004}^{+0.008}$ | 44.70 | 1.5               | 2   |  | MI-283628       | 51                  | 1.5             | 0.360     |
| 50.800(2)                 | 63.500(2 $\frac{1}{2}$ ) $_{-0.013}^0$        | 38.35 | 2                 | 2   |  | MI-324024       | 59                  | 2               | 0.340     |
|                           | 63.500(2 $\frac{1}{2}$ ) $_{-0.013}^0$        | 44.70 | 2                 | 2   |  | MI-324028       | 59                  | 2               | 0.420     |
| 57.150(2 $\frac{1}{4}$ )  | 69.850(2 $\frac{3}{4}$ ) $_{-0.013}^0$        | 25.65 | 2                 | 2.2 |  | MI-364416       | 65                  | 2               | 0.257     |
|                           | 69.850(2 $\frac{3}{4}$ ) $_{-0.013}^0$        | 38.35 | 2                 | 2.2 |  | MI-364424       | 65                  | 2               | 0.384     |
|                           | 69.850(2 $\frac{3}{4}$ ) $_{-0.013}^0$        | 44.70 | 2                 | 2.2 |  | MI-364428       | 65                  | 2               | 0.447     |
| 63.500(2 $\frac{1}{2}$ )  | 76.200(3) $_{-0.013}^0$                       | 38.35 | 2                 | 2.2 |  | MI-404824       | 71.5                | 2               | 0.417     |
|                           | 76.200(3) $_{-0.013}^0$                       | 44.70 | 2                 | 2.2 |  | MI-404828       | 71.5                | 2               | 0.486     |
| 66.675(2 $\frac{5}{8}$ )  | 82.550(3 $\frac{1}{4}$ ) $_{-0.015}^0$        | 44.70 | 2                 | 2.2 |  | MI-425228       | 74.5                | 2               | 0.648     |
|                           | 82.550(3 $\frac{1}{4}$ ) $_{-0.015}^0$        | 51.05 | 2                 | 2.2 |  | MI-425232       | 74.5                | 2               | 0.740     |
| 69.850(2 $\frac{3}{4}$ )  | 82.550(3 $\frac{1}{4}$ ) $_{-0.015}^0$        | 44.70 | 2                 | 2.2 |  | MI-445228       | 78                  | 2               | 0.530     |
| 76.200(3)                 | 88.900(3 $\frac{1}{2}$ ) $_{-0.015}^0$        | 44.70 | 2                 | 2.2 |  | MI-485628       | 84                  | 2               | 0.574     |
|                           | 88.900(3 $\frac{1}{2}$ ) $_{-0.015}^0$        | 51.05 | 2                 | 2.2 |  | MI-485632       | 84                  | 2               | 0.655     |
| 79.375(3 $\frac{1}{8}$ )  | 95.250(3 $\frac{3}{4}$ ) $_{-0.015}^0$        | 51.05 | 2.5               | 2.2 |  | MI-506032       | 88.5                | 2.5             | 0.862     |
| 85.725(3 $\frac{3}{8}$ )  | 101.600(4) $_{-0.015}^0$                      | 51.05 | 2.5               | 2.5 |  | MI-546432       | 94.5                | 2.5             | 0.930     |
| 92.075(3 $\frac{5}{8}$ )  | 107.950(4 $\frac{1}{4}$ ) $_{-0.015}^0$       | 51.05 | 2.5               | 2.5 |  | MI-586832       | 101                 | 2.5             | 1.00      |
| 95.250(3 $\frac{3}{4}$ )  | 114.300(4 $\frac{1}{2}$ ) $_{-0.015}^0$       | 57.40 | 2.5               | 2.5 |  | MI-607236       | 104                 | 2.5             | 1.40      |
| 98.425(3 $\frac{7}{8}$ )  | 114.300(4 $\frac{1}{2}$ ) $_{-0.015}^0$       | 57.40 | 2.5               | 2.5 |  | MI-627236       | 107.5               | 2.5             | 1.15      |
|                           | 114.300(4 $\frac{1}{2}$ ) $_{-0.015}^0$       | 63.88 | 2.5               | 2.5 |  | MI-627240       | 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  $r$ .

$d$  101.600~203.200mm

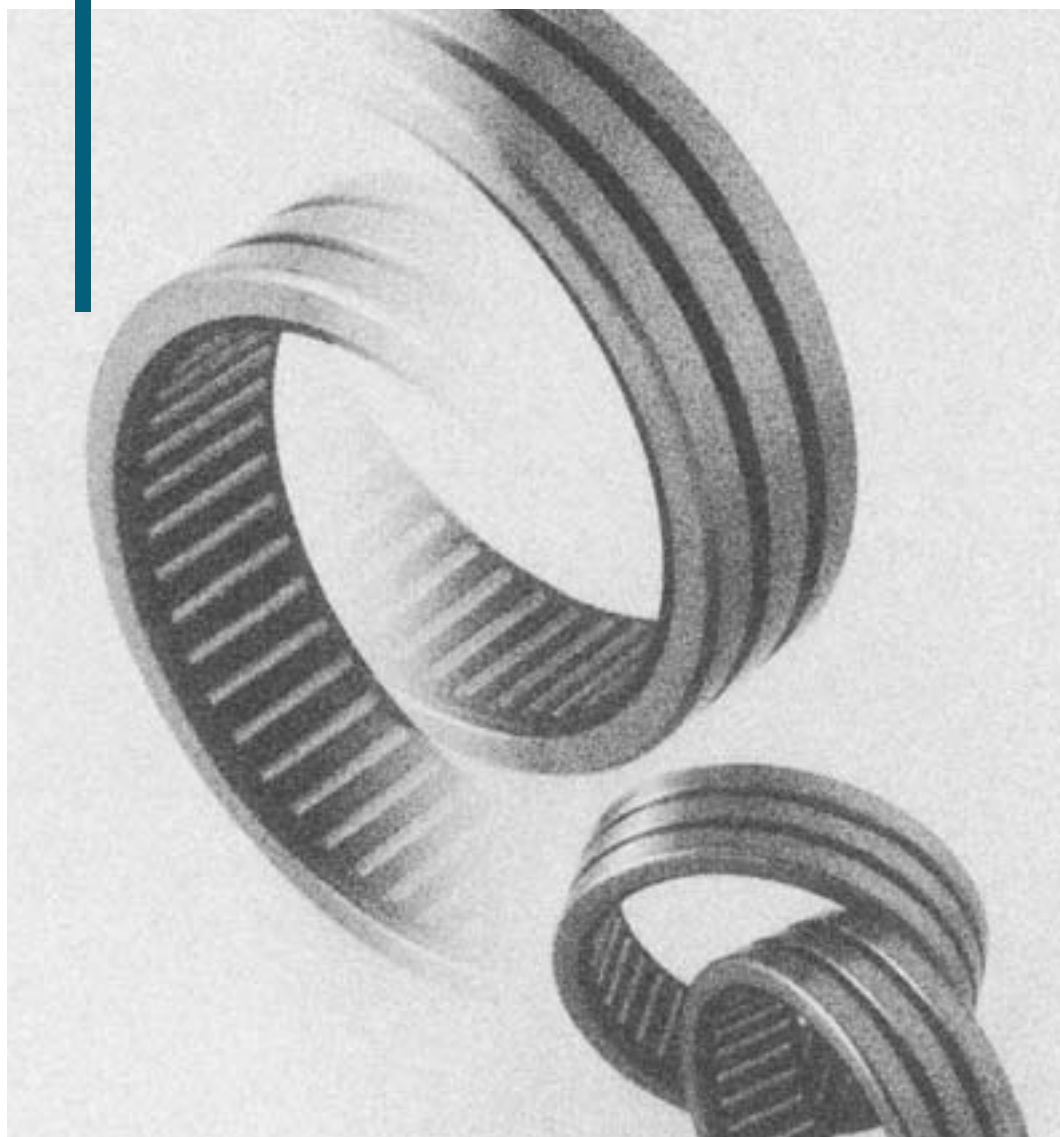
| Boundary dimensions       |                                                                                       |       |                  |     |              | Bearing numbers | Abutment dimensions |           | Mass |
|---------------------------|---------------------------------------------------------------------------------------|-------|------------------|-----|--------------|-----------------|---------------------|-----------|------|
| mm ( $\frac{1}{25.4}$ mm) |                                                                                       |       |                  |     |              |                 | mm                  |           | kg   |
| $d$                       | $F^{1)}$                                                                              | $B$   | $r_{s\min}^{2)}$ | $t$ | $d_a$<br>min |                 | $r_{as}$<br>max     | (approx.) |      |
| 101.600(4)                | 127.000(5)                                                                            | 51.05 | 2.5              | 2.5 | MI-648032    | 110.5           | 2.5                 | 1.82      |      |
|                           | 127.000(5)<br>$\begin{smallmatrix} 0 \\ -0.018 \end{smallmatrix}$                     | 57.40 | 2.5              | 2.5 | MI-648036    | 110.5           | 2.5                 | 2.05      |      |
|                           | 127.000(5)                                                                            | 63.88 | 2.5              | 2.5 | MI-648040    | 110.5           | 2.5                 | 2.28      |      |
| 114.300(4 $\frac{1}{2}$ ) | 139.700(5 $\frac{1}{2}$ )<br>$\begin{smallmatrix} 0 \\ -0.018 \end{smallmatrix}$      | 63.88 | 2.5              | 2.5 | MI-728840    | 123.5           | 2.5                 | 2.58      |      |
|                           | 139.700(5 $\frac{1}{2}$ )                                                             | 76.58 | 2.5              | 2.5 | MI-728848    | 123.5           | 2.5                 | 3.10      |      |
| 120.650(4 $\frac{3}{4}$ ) | 146.050(5 $\frac{3}{4}$ )<br>$\begin{smallmatrix} 0 \\ -0.018 \end{smallmatrix}$      | 76.58 | 3                | 3   | MI-769248    | 132             | 3                   | 3.18      |      |
| 127.000(5)                | 152.400(6)<br>$\begin{smallmatrix} 0 \\ -0.018 \end{smallmatrix}$                     | 63.88 | 3                | 3   | MI-809640    | 140             | 3                   | 2.80      |      |
|                           | 152.400(6)                                                                            | 76.58 | 3                | 3   | MI-809648    | 140             | 3                   | 3.35      |      |
| 139.700(5 $\frac{1}{2}$ ) | 165.100(6 $\frac{1}{2}$ )<br>$\begin{smallmatrix} -0.010 \\ -0.028 \end{smallmatrix}$ | 63.88 | 3                | 3   | MI-8810440   | 152.5           | 3                   | 2.84      |      |
|                           | 165.100(6 $\frac{1}{2}$ )                                                             | 76.58 | 3                | 3   | MI-8810448   | 152.5           | 3                   | 3.40      |      |
| 152.400(6)                | 184.150(7 $\frac{1}{4}$ )<br>$\begin{smallmatrix} -0.013 \\ -0.033 \end{smallmatrix}$ | 76.58 | 3                | 3   | MI-9611648   | 165.5           | 3                   | 4.80      |      |
| 165.100(6 $\frac{1}{2}$ ) | 196.850(7 $\frac{3}{4}$ )<br>$\begin{smallmatrix} -0.013 \\ -0.043 \end{smallmatrix}$ | 76.58 | 3                | 3   | MI-10412448  | 178             | 3                   | 5.30      |      |
| 177.800(7)                | 209.550(8 $\frac{1}{4}$ )<br>$\begin{smallmatrix} -0.013 \\ -0.043 \end{smallmatrix}$ | 76.58 | 3                | 3   | MI-11213248  | 191             | 3                   | 5.60      |      |
| 190.500(7 $\frac{1}{2}$ ) | 222.250(8 $\frac{3}{4}$ )<br>$\begin{smallmatrix} -0.020 \\ -0.050 \end{smallmatrix}$ | 76.58 | 4                | 3   | MI-12014048  | 206.5           | 4                   | 6.10      |      |
| 203.200(8)                | 234.950(9 $\frac{1}{4}$ )<br>$\begin{smallmatrix} -0.033 \\ -0.063 \end{smallmatrix}$ | 76.58 | 4                | 3.5 | MI-12814848  | 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  $r^*$ .



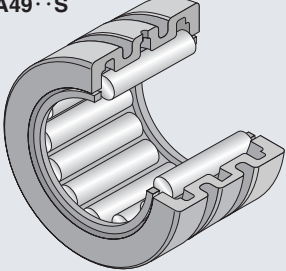
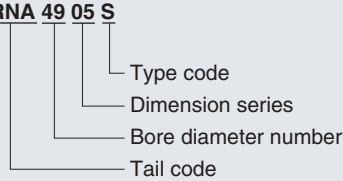
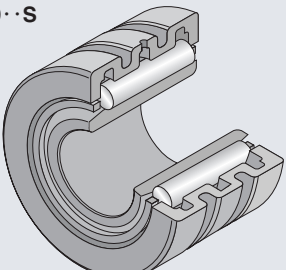
## Adjustable-Clearance Needle Roller Bearings



## Clearance-Adjustable Needle Roller Bearings

This bearing type comprises a solid outer ring with special machined section and needle rollers and cage built in the outer ring. The outer ring, needle rollers and cage are inseparable from each other. The raceway diameter of the outer ring is shrunk and the roller inscribed circle diameter ( $F_w$ ) is reduced correspondingly by pressing the outer ring in axial direction.

The radial clearance is fine-adjustable by an load to be applied to the bearing in axial direction, that is, axial shrinkage of the outer ring. This bearing type is mainly applied to the work spindle of a machine tool etc. which require high running accuracy, whose accuracy class is JIS Class-4.

| Bearing type                                                                                              | Applied shaft diameter (mm) | Composition of nominal bearing number                                                                    | Remarks                                                                                                                                                        |
|-----------------------------------------------------------------------------------------------------------|-----------------------------|----------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Type RNA49··S</b><br> | $\phi 30 \sim \phi 125$     | <b>RNA 49 05 S</b><br> | The dimensional accuracy, profile accuracy and running accuracy conform to JIS Class-4 so as to be available for applications requiring high running accuracy. |
| <b>Type NA49··S</b><br> | $\phi 25 \sim \phi 110$     | <b>[Tail code]</b><br>S: Clearance-adjustable type                                                       | Another inner ring type with grinding allowance for its raceway surface can also be supplied upon request.                                                     |

### 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. Higher running accuracy can be achieved by finishing the inner ring raceway surface with grinding allowance by grinding, after the inner ring was press-fitted on a shaft. Feel free to contact NTN for the more detailed information.

### Radial clearance and bearing fits

The Type **NA49··S** with inner ring has a radial clearance smaller than the specific ordinary clearance, while the radial clearance of Type **RNA49··S** without inner ring is determined by shaft diameter being selected per applicable "Dimensions Table" which specifies the dimensional tolerances for the roller inscribed circle diameter ( $F_w$ ).

The outer ring must be fitted in a housing by "close fit" or "tight fit" (interference of approximately  $5 \mu\text{m}$ ) to shrink the raceway diameter by pressing the outer ring in axial direction.

Bearing fit on a shaft and in a housing shall be per **Table 1**.

**Table 1 Bearing fit in shaft and housing**

| Bearing type        | Shaft    | Housing |
|---------------------|----------|---------|
| RNA49··S<br>NA49··S | m5<br>k5 | K4      |

### 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**

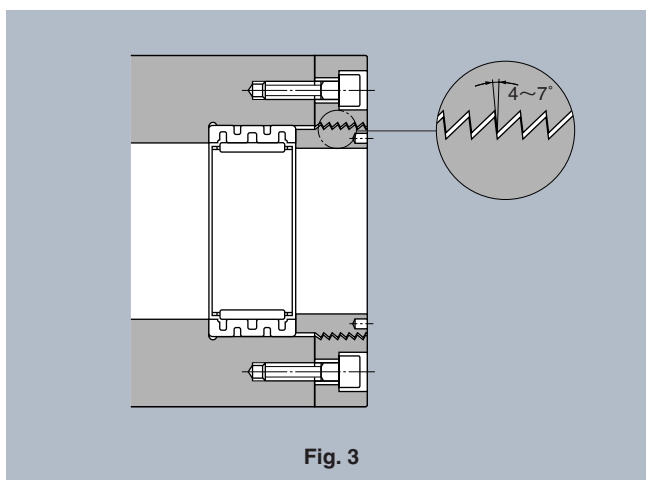
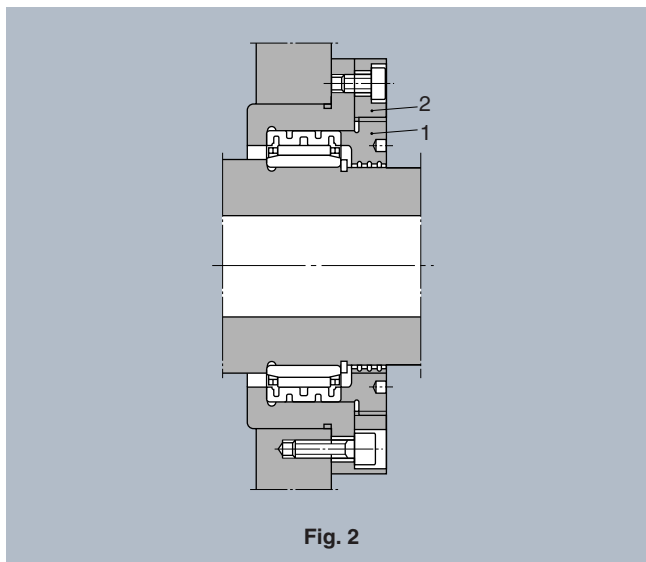
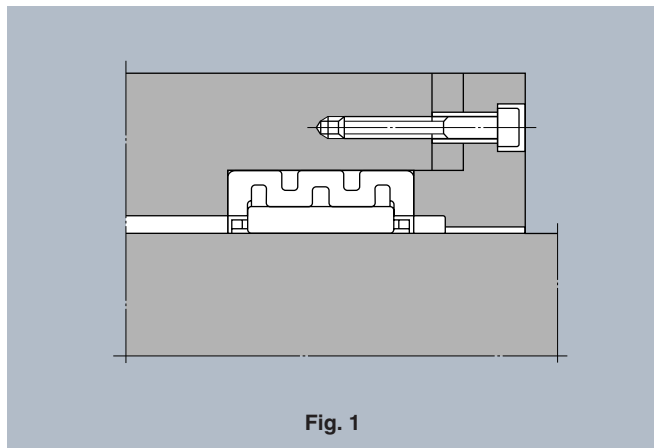
| Characteristics                 | Shaft | Housing |
|---------------------------------|-------|---------|
| Roundness (max)                 | IT2   | IT3     |
| Cylindricity (max)              | IT2   | IT3     |
| Shoulder perpendicularity (max) | IT3   | IT3     |



## How to adjust radial clearance

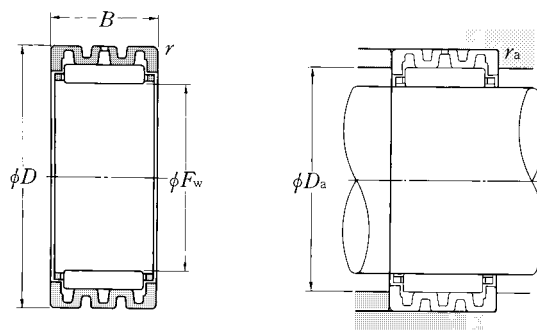
The ratio of outer ring axial shrinkage to shrinkage of roller inscribed circle diameter ( $F_w$ ) is nearly 3:1. In other words, the outer ring must be tightened by 3 mm in axial direction to make the radial clearance smaller by 1 mm.

For adjustment of the radial clearance, the outer ring must be tightened uniformly in parallel to the shaft center. In the case of adjustment by the method illustrated in **Fig.1**, a specific axial tightening value can be obtained by changing the thickness of a spacer, which was inserted between the housing and the lid, by lapping the spacer or replacing it with another spacer. In the case of adjustment by the method illustrated in **Fig.2**, the fixed ring 2 is fitted in the housing and, thereafter, the threaded lid 1 is screwed in until it comes in contact with the outer ring for zero setting. Then, the threaded lid 1 is further screwed in by the required value, after the fixed ring was loosened, and thereafter the fixed ring 2 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.



## Without inner ring

## Type RNA49·S

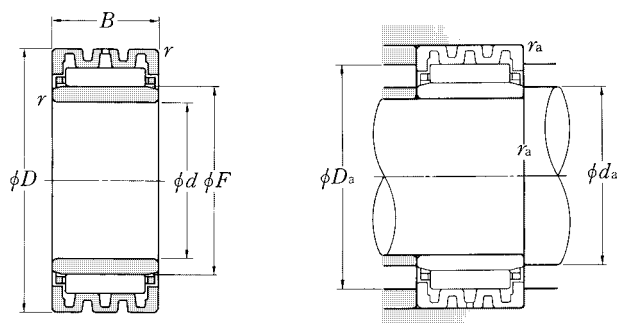

 $F_w$  30~125mm

| Boundary dimensions              |     |     |                   |  | Basic load ratings |          |         |          | Limiting speeds |        | Bearing numbers | Abutment dimensions |                 | Mass      |
|----------------------------------|-----|-----|-------------------|--|--------------------|----------|---------|----------|-----------------|--------|-----------------|---------------------|-----------------|-----------|
|                                  |     |     |                   |  | dynamic            | static   | dynamic | static   |                 |        |                 |                     |                 |           |
| mm                               |     |     |                   |  | N                  |          | kgf     |          | r/min           |        |                 | mm                  |                 | kg        |
| $F_w$                            | $D$ | $B$ | $r_{s\ min}^{1)}$ |  | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ | grease          | oil    |                 | $D_a$<br>max        | $r_{as}$<br>max | (approx.) |
| 30 <sup>+0.031<br/>+0.022</sup>  | 42  | 17  | 0.3               |  | 12 300             | 16 000   | 1 260   | 1 630    | 8 700           | 13 000 | RNA 4905S       | 36                  | 0.3             | 0.070     |
| 35 <sup>+0.038<br/>+0.028</sup>  | 47  | 17  | 0.3               |  | 14 900             | 21 600   | 1 520   | 2 200    | 7 300           | 11 000 | RNA 4906S       | 41                  | 0.3             | 0.086     |
| 40 <sup>+0.038<br/>+0.028</sup>  | 52  | 20  | 0.6               |  | 17 600             | 27 800   | 1 790   | 2 830    | 6 700           | 10 000 | RNA49/32S       | 46                  | 0.6             | 0.088     |
| 42 <sup>+0.038<br/>+0.028</sup>  | 55  | 20  | 0.6               |  | 18 300             | 29 800   | 1 870   | 3 050    | 6 300           | 9 500  | RNA 4907S       | 48                  | 0.6             | 0.099     |
| 48 <sup>+0.038<br/>+0.028</sup>  | 62  | 22  | 0.6               |  | 22 500             | 40 500   | 2 300   | 4 150    | 5 700           | 8 500  | RNA 4908S       | 54                  | 0.6             | 0.134     |
| 52 <sup>+0.045<br/>+0.035</sup>  | 68  | 22  | 0.6               |  | 23 100             | 43 500   | 2 360   | 4 400    | 5 000           | 7 500  | RNA 4909S       | 58                  | 0.6             | 0.168     |
| 58 <sup>+0.045<br/>+0.035</sup>  | 72  | 22  | 0.6               |  | 24 700             | 49 000   | 2 520   | 5 000    | 4 700           | 7 000  | RNA 4910S       | 64                  | 0.6             | 0.189     |
| 63 <sup>+0.045<br/>+0.035</sup>  | 80  | 25  | 1                 |  | 33 000             | 65 500   | 3 350   | 6 650    | 4 300           | 6 500  | RNA 4911S       | 70                  | 1               | 0.212     |
| 68 <sup>+0.045<br/>+0.035</sup>  | 85  | 25  | 1                 |  | 34 000             | 69 000   | 3 450   | 7 050    | 4 000           | 6 000  | RNA 4912S       | 75                  | 1               | 0.257     |
| 72 <sup>+0.045<br/>+0.035</sup>  | 90  | 25  | 1                 |  | 34 000             | 70 500   | 3 450   | 7 200    | 3 700           | 5 500  | RNA 4913S       | 79                  | 1               | 0.286     |
| 80 <sup>+0.045<br/>+0.035</sup>  | 100 | 30  | 1                 |  | 44 500             | 94 000   | 4 550   | 9 600    | 3 300           | 5 000  | RNA 4914S       | 88                  | 1               | 0.422     |
| 85 <sup>+0.055<br/>+0.040</sup>  | 105 | 30  | 1                 |  | 45 500             | 99 000   | 4 650   | 10 100   | 3 100           | 4 700  | RNA 4915S       | 93                  | 1               | 0.451     |
| 90 <sup>+0.055<br/>+0.040</sup>  | 110 | 30  | 1                 |  | 46 500             | 104 000  | 4 750   | 10 600   | 2 900           | 4 400  | RNA 4916S       | 98                  | 1               | 0.468     |
| 100 <sup>+0.055<br/>+0.040</sup> | 120 | 35  | 1.1               |  | 57 000             | 140 000  | 5 800   | 14 300   | 2 700           | 4 000  | RNA 4917S       | 108                 | 1               | 0.594     |
| 105 <sup>+0.055<br/>+0.040</sup> | 125 | 35  | 1.1               |  | 58 500             | 146 000  | 5 950   | 14 900   | 2 500           | 3 800  | RNA 4918S       | 113                 | 1               | 0.617     |
| 110 <sup>+0.055<br/>+0.040</sup> | 130 | 35  | 1.1               |  | 59 500             | 152 000  | 6 050   | 15 500   | 2 400           | 3 600  | RNA 4919S       | 118                 | 1               | 0.735     |
| 115 <sup>+0.055<br/>+0.040</sup> | 140 | 40  | 1.1               |  | 72 000             | 168 000  | 7 350   | 17 100   | 2 300           | 3 500  | RNA 4920S       | 125                 | 1               | 0.980     |
| 125 <sup>+0.065<br/>+0.050</sup> | 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  $r$ '.

# With inner ring

## Type NA49··S



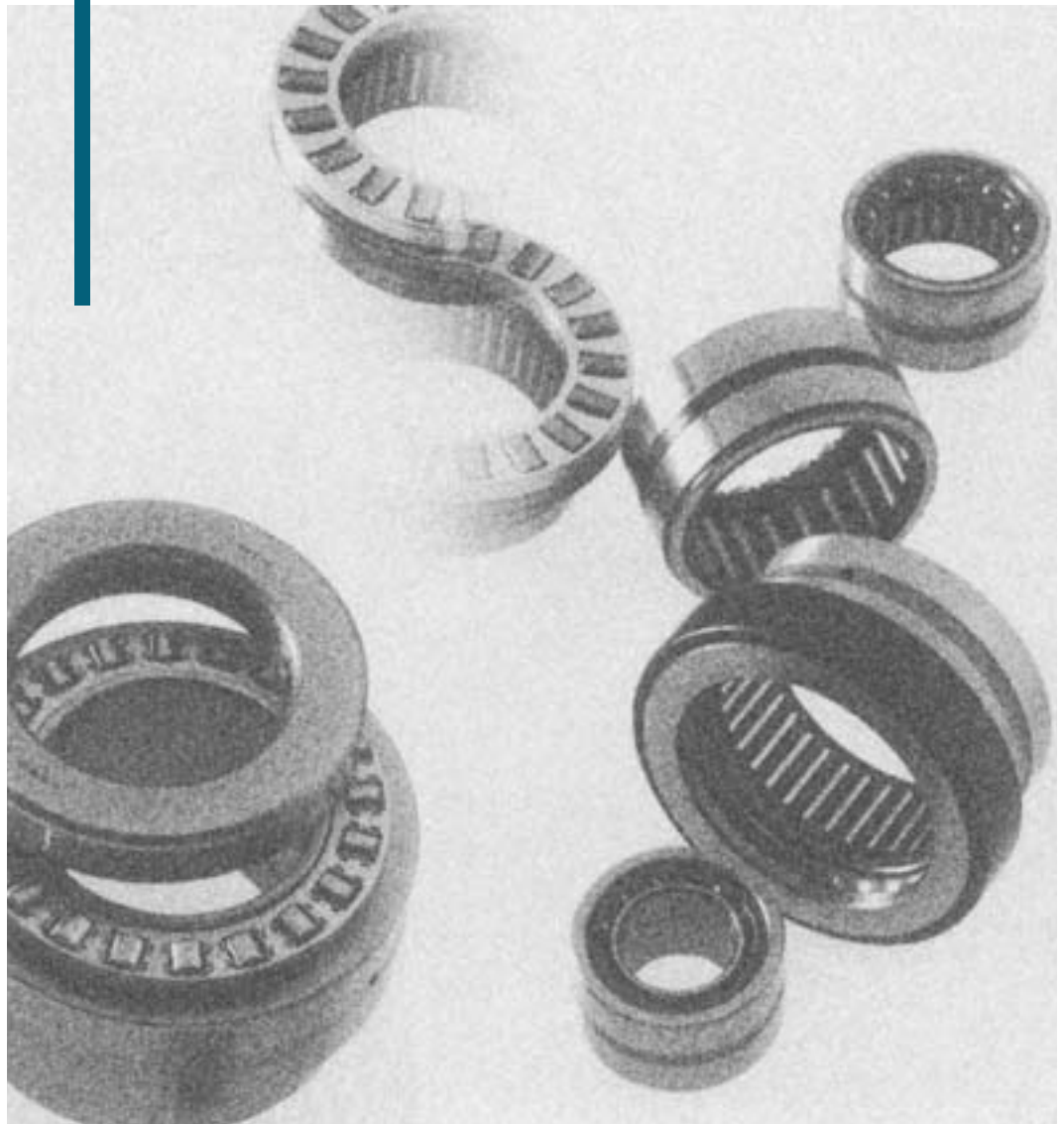
$d$  25~110mm

| Boundary dimensions |     |     |                  |     | Basic load ratings |          |         |          | Limiting speeds |        | Bearing numbers | Bearing clearanc before installation | Abutment dimensions |       |          | Mass      |
|---------------------|-----|-----|------------------|-----|--------------------|----------|---------|----------|-----------------|--------|-----------------|--------------------------------------|---------------------|-------|----------|-----------|
|                     |     |     |                  |     | dynamic            | static   | dynamic | static   |                 |        |                 |                                      | mm                  |       |          |           |
| mm                  |     |     |                  |     | N                  |          | kgf     |          | r/min           |        |                 |                                      | $d_a$               | $D_a$ | $r_{as}$ | kg        |
| $d$                 | $D$ | $B$ | $r_{s\min}^{1)}$ | $F$ | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ | grease          | oil    |                 | $\mu m$                              | 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  $r$ .



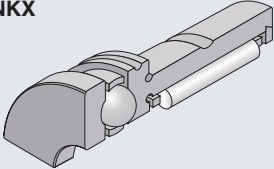
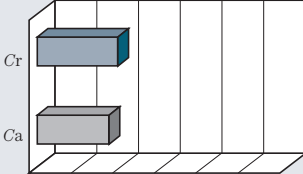
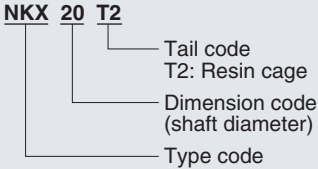
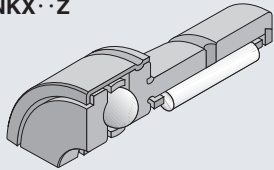
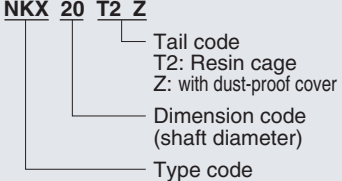
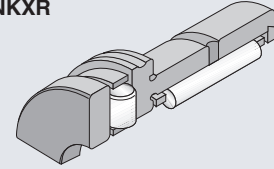
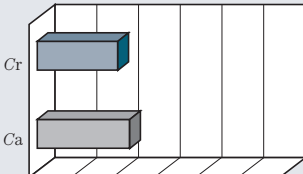
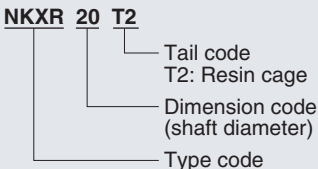
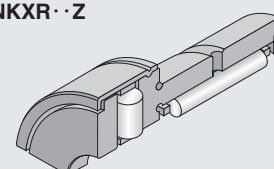
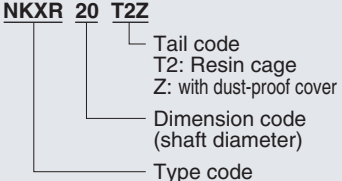
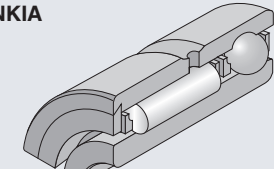
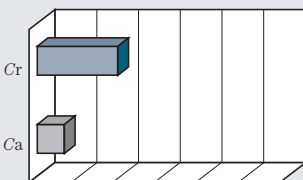
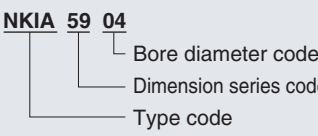
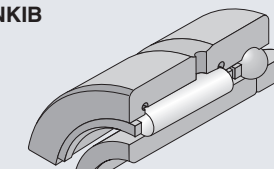
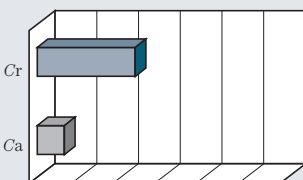
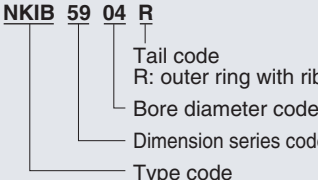
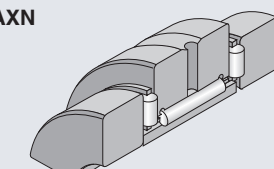
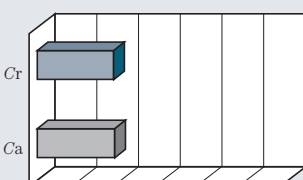
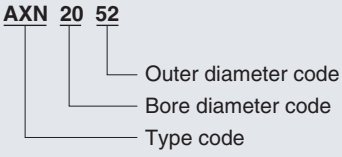
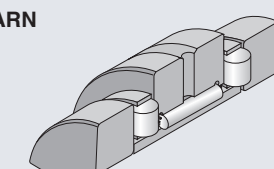
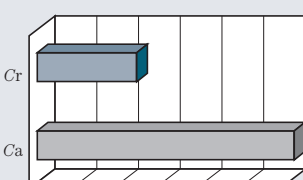
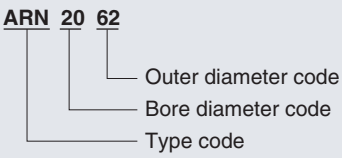
## Complex Bearings



## Complex Bearings

NTN complex bearing is composed of a radial needle roller bearing to support radial load and a thrust ball bearing or a thrust roller bearing to support axial load which are integrated into one bearing unit. 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                                                                                                | Applied shaft diameter (mm) | Load capacity                                                                        | Composition of nominal bearing number                                                                        |
|-------------------------------------------------------------------------------------------------------------|-----------------------------|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| <b>Type NKX</b><br>        | $\phi 10 \sim \phi 70$      |    | <b>NKX 20 T2</b><br>      |
| <b>Type NKX · Z</b><br>    |                             |                                                                                      | <b>NKX 20 T2 Z</b><br>    |
| <b>Type NKXR</b><br>      | $\phi 15 \sim \phi 50$      |  | <b>NKXR 20 T2</b><br>    |
| <b>Type NKXR · Z</b><br> |                             |                                                                                      | <b>NKXR 20 T2Z</b><br>  |
| <b>Type NKIA</b><br>     | $\phi 15 \sim \phi 70$      |  | <b>NKIA 59 04</b><br>   |
| <b>Type NKIB</b><br>     | $\phi 15 \sim \phi 70$      |  | <b>NKIB 59 04 R</b><br> |
| <b>Type AXN</b><br>      | $\phi 20 \sim \phi 50$      |  | <b>AXN 20 52</b><br>    |
| <b>Type ARN</b><br>      | $\phi 20 \sim \phi 70$      |  | <b>ARN 20 62</b><br>    |

※Each listed load capacity is subject to reference bearing bore diameter of  $\phi 20$ .

| Bearing components                                                                                                                                                                                                           | Handling characteristic                                                                                                                 | Features                                                                                                                                                                                                                                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Inscribed circle diameter (shaft dia.) : $\phi 20$<br>Radial bearing : Needle roller type<br>Iron cage<br>Thrust bearing : Ball type<br>Resin cage<br>Dust-proof cover : without<br>Thrust plate : Separable                 | <br>Separable thrust plate<br>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.) : $\phi 20$<br>Radial bearing : Needle roller type<br>Iron cage<br>Thrust bearing : Ball type<br>Resin cage<br>Dust-proof cover : with<br>Thrust plate : Non-separable, integral type | <br>Integral thrust plate<br>With dust-proof cover     | This type is identical to NKZ, 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 integral.           |
| Inscribed circle diameter (shaft dia.) : $\phi 20$<br>Radial bearing : Needle roller type<br>Iron cage<br>Thrust bearing : Ball type<br>Resin cage<br>Dust-proof cover : without<br>Thrust plate : Separable                 | <br>Separable thrust plate<br>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.) : $\phi 20$<br>Radial bearing : Needle roller type<br>Iron cage<br>Thrust bearing : Ball type<br>Resin cage<br>Dust-proof cover : with<br>Thrust plate : Non-separable, integral type | <br>Integral thrust plate<br>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.) : $\phi 20$<br>Radial bearing : Needle roller type<br>Thrust bearing : Angular type                                                                                                   | <br>Integral angular bearing<br>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.) : $\phi 20$<br>Radial bearing : Needle roller type<br>Outer ring with rib<br>Thrust bearing : Three-point contact angular type                                                        | <br>Double inner ring type<br>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.) : $\phi 20$<br>Outer ring outer diameter : 52<br>Radial bearing : Needle roller type<br>Thrust bearing : Needle roller type                                                           | <br>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.) : $\phi 20$<br>Outer ring outer diameter : 62<br>Radial bearing : Needle roller type<br>Thrust bearing : Cylindrical roller type                                                      | <br>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 radial inner ring $K_{ia}$ |         | Allowable radial run-out for outer ring $K_{ea}$ |         |
|----------------------------------------------------------------------|-------|---------------------------------------------|---------|--------------------------------------------------|---------|
| Over                                                                 | Incl. | 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       |

① To be determined based on " $d$ ".

② To be determined based on " $D$ ".

## Radial clearance

The respective radial clearances of **Type NKX+IR**, **NKXR+IR**, **NKIA** and **NKIB** shall comply with the interchangeable clearances specified in **Table 5.1** (1) of 5.1 "Radial Clearances of Bearings" (page A-30). The standard bearings are manufactured subject to the regular clearances.

The radial clearances of **Type AXN** and **ARN** is special clearance, as specified in applicable Dimensions 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.

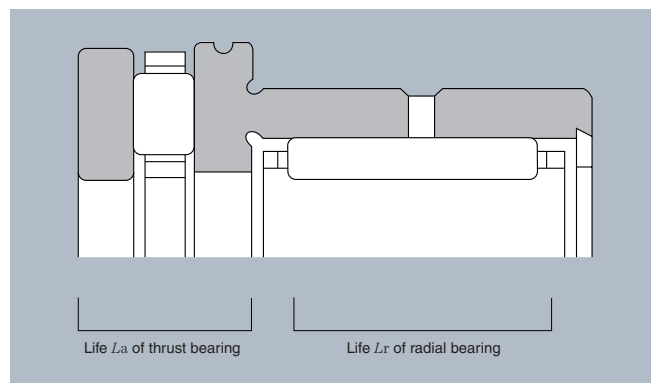
**Table 2 Bearing fit on shaft and in housing**

| 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 rated life

The rated life ( $L$ ) of any complex bearing is determined as follows. Determine individually the rated life ( $L_r$ ) of radial needle roller bearing from radial load acting thereon and the rated life ( $L_a$ ) of thrust bearing from axial load acting thereon. And determine the rated life ( $L$ ) from these determined rated lives ( $L_r$ ,  $L_a$ ) using the following formula



Rated life  $L$  of complex bearing

$$L = \frac{1}{\left( \frac{1}{L_r^{1.1}} + \frac{1}{L_a^{1.1}} \right)^{0.91}} \dots\dots\dots (1)$$

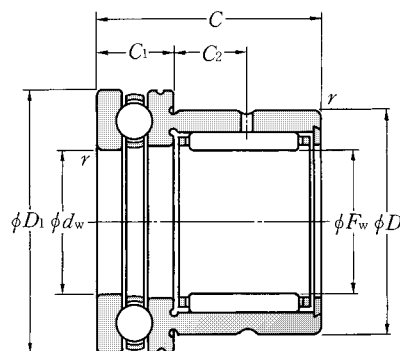
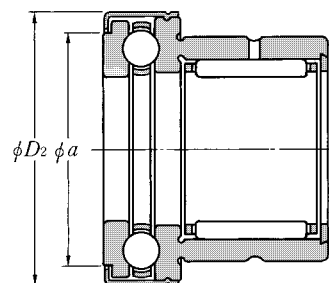




## Without inner ring

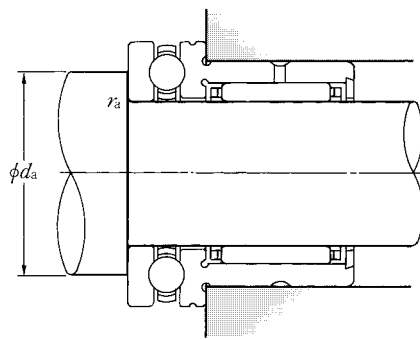
## Type NKX

## Type NKX··Z

Type NKX  
(Open type)Type NKX··Z  
(With cover)
 $F_w$  10~70mm

| Boundary dimensions |                                                          |     |                                                          |                |                |       |                    |       |      |                | Basic load ratings |          |         |        |       |
|---------------------|----------------------------------------------------------|-----|----------------------------------------------------------|----------------|----------------|-------|--------------------|-------|------|----------------|--------------------|----------|---------|--------|-------|
|                     |                                                          |     |                                                          |                |                |       |                    |       |      |                | dynamic            | static   | dynamic | static |       |
| $F_w$               | $d_w$                                                    | $D$ | $D_1$                                                    | mm             |                |       |                    | $C_2$ | $a$  | $r_s \min ^1)$ | N                  | kgf      |         |        |       |
|                     |                                                          |     |                                                          | $C_0$<br>-0.25 | $C_1$<br>-0.20 | $C_r$ | Radial<br>$C_{or}$ |       |      |                | $C_r$              | $C_{or}$ |         |        |       |
| 10                  | $\begin{smallmatrix} +0.022 \\ +0.013 \end{smallmatrix}$ | 10  | $\begin{smallmatrix} +0.040 \\ +0.025 \end{smallmatrix}$ | 19             | 24             | 25    | 23                 | 9     | 6.5  | 19.7           | 0.3                | 5 450    | 6 450   | 555    | 660   |
| 12                  | $\begin{smallmatrix} +0.027 \\ +0.016 \end{smallmatrix}$ | 12  | $\begin{smallmatrix} +0.050 \\ +0.032 \end{smallmatrix}$ | 21             | 26             | 27    | 23                 | 9     | 6.5  | 21.7           | 0.3                | 6 000    | 7 700   | 615    | 785   |
| 15                  | $\begin{smallmatrix} +0.027 \\ +0.016 \end{smallmatrix}$ | 15  | $\begin{smallmatrix} +0.050 \\ +0.032 \end{smallmatrix}$ | 24             | 28             | 29    | 23                 | 9     | 6.5  | 23.7           | 0.3                | 8 250    | 10 200  | 840    | 1 040 |
| 17                  | $\begin{smallmatrix} +0.027 \\ +0.016 \end{smallmatrix}$ | 17  | $\begin{smallmatrix} +0.050 \\ +0.032 \end{smallmatrix}$ | 26             | 30             | 31    | 25                 | 9     | 8    | 25.7           | 0.3                | 10 400   | 14 400  | 1 060  | 1 460 |
| 20                  | $\begin{smallmatrix} +0.033 \\ +0.020 \end{smallmatrix}$ | 20  | $\begin{smallmatrix} +0.061 \\ +0.040 \end{smallmatrix}$ | 30             | 35             | 36    | 30                 | 10    | 10.5 | 30.7           | 0.3                | 16 400   | 27 100  | 1 670  | 2 760 |
| 25                  | $\begin{smallmatrix} +0.033 \\ +0.020 \end{smallmatrix}$ | 25  | $\begin{smallmatrix} +0.061 \\ +0.040 \end{smallmatrix}$ | 37             | 42             | 43    | 30                 | 11    | 9.5  | 37.7           | 0.6                | 14 200   | 24 000  | 1 450  | 2 450 |
| 30                  | $\begin{smallmatrix} +0.033 \\ +0.020 \end{smallmatrix}$ | 30  | $\begin{smallmatrix} +0.061 \\ +0.040 \end{smallmatrix}$ | 42             | 47             | 48    | 30                 | 11    | 9.5  | 42.7           | 0.6                | 22 300   | 39 500  | 2 280  | 4 000 |
| 35                  | $\begin{smallmatrix} +0.041 \\ +0.025 \end{smallmatrix}$ | 35  | $\begin{smallmatrix} +0.075 \\ +0.050 \end{smallmatrix}$ | 47             | 52             | 53    | 30                 | 12    | 9    | 47.7           | 0.6                | 20 000   | 36 000  | 2 040  | 3 650 |
| 40                  | $\begin{smallmatrix} +0.041 \\ +0.025 \end{smallmatrix}$ | 40  | $\begin{smallmatrix} +0.075 \\ +0.050 \end{smallmatrix}$ | 52             | 60             | 61    | 32                 | 13    | 10   | 55.7           | 0.6                | 25 900   | 52 500  | 2 650  | 5 350 |
| 45                  | $\begin{smallmatrix} +0.041 \\ +0.025 \end{smallmatrix}$ | 45  | $\begin{smallmatrix} +0.075 \\ +0.050 \end{smallmatrix}$ | 58             | 65             | 66.5  | 32                 | 14    | 9    | 60.5           | 0.6                | 27 600   | 59 000  | 2 810  | 6 000 |
| 50                  | $\begin{smallmatrix} +0.041 \\ +0.025 \end{smallmatrix}$ | 50  | $\begin{smallmatrix} +0.075 \\ +0.050 \end{smallmatrix}$ | 62             | 70             | 71.5  | 35                 | 14    | 10   | 65.5           | 0.6                | 27 900   | 62 000  | 2 850  | 6 300 |
| 60                  | $\begin{smallmatrix} +0.049 \\ +0.030 \end{smallmatrix}$ | 60  | $\begin{smallmatrix} +0.090 \\ +0.060 \end{smallmatrix}$ | 72             | 85             | 86.5  | 40                 | 17    | 12   | 80.5           | 1                  | 29 800   | 71 500  | 3 050  | 7 300 |
| 70                  | $\begin{smallmatrix} +0.049 \\ +0.030 \end{smallmatrix}$ | 70  | $\begin{smallmatrix} +0.090 \\ +0.060 \end{smallmatrix}$ | 85             | 95             | 96.5  | 40                 | 18    | 11   | 90.5           | 1                  | 36 500   | 86 000  | 3 700  | 8 750 |

Note 1) Allowable minimum chamfer dimension  $r'$ .

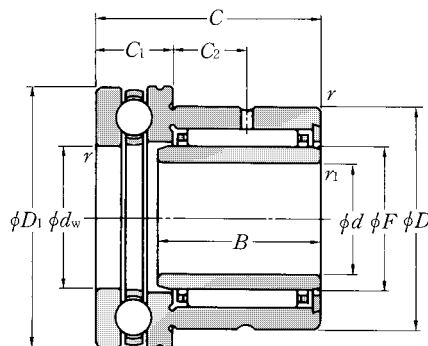
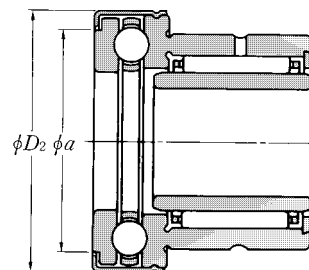


| dynamic<br>N | Basic load ratings |         |          |         | Limiting<br>dimensions<br>r/min |       | Bearing numbers |                | Abutment<br>dimensions<br>mm |                 | Mass<br>(approx.)<br>kg |                |
|--------------|--------------------|---------|----------|---------|---------------------------------|-------|-----------------|----------------|------------------------------|-----------------|-------------------------|----------------|
|              | static             | dynamic | static   | dynamic |                                 |       |                 |                |                              |                 |                         |                |
|              | Axial              |         |          |         |                                 |       |                 |                |                              |                 |                         |                |
| $C_a$        | $C_{oa}$           | $C_a$   | $C_{oa}$ | kgf     | grease                          | oil   | Type<br>NKX     | Type<br>NKX··Z | $d_a$<br>min                 | $r_{as}$<br>max | Type<br>NKX             | Type<br>NKX··Z |
| 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

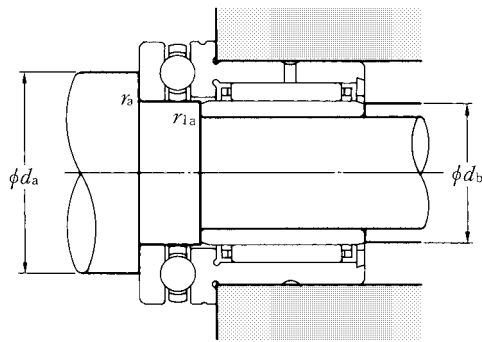
Type NKX+IR  
(Open type)Type NKX·Z+IR  
(With cover)

d 7~60mm

| Boundary dimensions |    |                                                          |    |    |      |                                                    |                                                    |    |      |    |                 |                  | Basic load ratings |             |                |               |              |             |                |               |
|---------------------|----|----------------------------------------------------------|----|----|------|----------------------------------------------------|----------------------------------------------------|----|------|----|-----------------|------------------|--------------------|-------------|----------------|---------------|--------------|-------------|----------------|---------------|
| d                   | dw | D                                                        | D1 | D2 | B    | C                                                  | C1                                                 | C2 | F    | a  | $r_{s \min}^1)$ | $r_{ls \min}^1)$ | dynamic<br>N       | static<br>N | dynamic<br>kgf | static<br>kgf | dynamic<br>N | static<br>N | dynamic<br>kgf | static<br>kgf |
|                     |    |                                                          |    |    |      | $\begin{smallmatrix} 0 \\ -0.25 \end{smallmatrix}$ | $\begin{smallmatrix} 0 \\ -0.20 \end{smallmatrix}$ |    |      |    |                 |                  | $C_r$              | $C_{or}$    | $C_r$          | $C_{or}$      | $C_a$        | $C_{oa}$    | $C_a$          | $C_{oa}$      |
| 7                   | 10 | $\begin{smallmatrix} +0.040 \\ +0.025 \end{smallmatrix}$ | 19 | 24 | 25   | 16                                                 | 23                                                 | 9  | 6.5  | 10 | 19.7            | 0.3              | 5 450              | 6 450       | 555            | 660           | 10 000       | 14 000      | 1 020          | 1 420         |
| 9                   | 12 | $\begin{smallmatrix} +0.050 \\ +0.032 \end{smallmatrix}$ | 21 | 26 | 27   | 16                                                 | 23                                                 | 9  | 6.5  | 12 | 21.7            | 0.3              | 6 000              | 7 700       | 615            | 785           | 10 300       | 15 400      | 1 050          | 1 570         |
| 12                  | 15 | $\begin{smallmatrix} +0.050 \\ +0.032 \end{smallmatrix}$ | 24 | 28 | 29   | 16                                                 | 23                                                 | 9  | 6.5  | 15 | 23.7            | 0.3              | 8 250              | 10 200      | 840            | 1 040         | 10 500       | 16 800      | 1 070          | 1 710         |
| 14                  | 17 | $\begin{smallmatrix} +0.050 \\ +0.032 \end{smallmatrix}$ | 26 | 30 | 31   | 17                                                 | 25                                                 | 9  | 8    | 17 | 25.7            | 0.3              | 10 400             | 14 400      | 1 060          | 1 460         | 10 800       | 18 200      | 1 100          | 1 850         |
| 17                  | 20 | $\begin{smallmatrix} +0.061 \\ +0.040 \end{smallmatrix}$ | 30 | 35 | 36   | 20                                                 | 30                                                 | 10 | 10.5 | 20 | 30.7            | 0.3              | 16 400             | 27 100      | 1 670          | 2 760         | 14 200       | 24 700      | 1 450          | 2 520         |
| 20                  | 25 | $\begin{smallmatrix} +0.061 \\ +0.040 \end{smallmatrix}$ | 37 | 42 | 43   | 20                                                 | 30                                                 | 11 | 9.5  | 25 | 37.7            | 0.6              | 14 200             | 24 000      | 1 450          | 2 450         | 19 600       | 37 000      | 1 990          | 3 800         |
| 25                  | 30 | $\begin{smallmatrix} +0.061 \\ +0.040 \end{smallmatrix}$ | 42 | 47 | 48   | 20                                                 | 30                                                 | 11 | 9.5  | 30 | 42.7            | 0.6              | 22 300             | 39 500      | 2 280          | 4 000         | 20 400       | 42 000      | 2 080          | 4 300         |
| 30                  | 35 | $\begin{smallmatrix} +0.075 \\ +0.050 \end{smallmatrix}$ | 47 | 52 | 53   | 20                                                 | 30                                                 | 12 | 9    | 35 | 47.7            | 0.6              | 20 000             | 36 000      | 2 040          | 3 650         | 20 400       | 44 500      | 2 080          | 4 550         |
| 35                  | 40 | $\begin{smallmatrix} +0.075 \\ +0.050 \end{smallmatrix}$ | 52 | 60 | 61   | 20                                                 | 32                                                 | 13 | 10   | 40 | 55.7            | 0.6              | 25 900             | 52 500      | 2 650          | 5 350         | 26 900       | 63 000      | 2 740          | 6 400         |
| 40                  | 45 | $\begin{smallmatrix} +0.075 \\ +0.050 \end{smallmatrix}$ | 58 | 65 | 66.5 | 20                                                 | 32                                                 | 14 | 9    | 45 | 60.5            | 0.6              | 27 600             | 59 000      | 2 810          | 6 000         | 27 900       | 69 000      | 2 840          | 7 050         |
| 45                  | 50 | $\begin{smallmatrix} +0.075 \\ +0.050 \end{smallmatrix}$ | 62 | 70 | 71.5 | 25                                                 | 35                                                 | 14 | 10   | 50 | 65.5            | 0.6              | 27 900             | 62 000      | 2 850          | 6 300         | 28 800       | 75 500      | 2 930          | 7 700         |
| 50                  | 60 | $\begin{smallmatrix} +0.090 \\ +0.060 \end{smallmatrix}$ | 72 | 85 | 86.5 | 25                                                 | 40                                                 | 17 | 12   | 60 | 80.5            | 1                | 29 800             | 71 500      | 3 050          | 7 300         | 41 500       | 113 000     | 4 200          | 11 500        |
| 60                  | 70 | $\begin{smallmatrix} +0.090 \\ +0.060 \end{smallmatrix}$ | 85 | 95 | 96.5 | 25                                                 | 40                                                 | 18 | 11   | 70 | 90.5            | 1                | 36 500             | 86 000      | 3 700          | 8 750         | 43 000       | 127 000     | 4 400          | 12 900        |

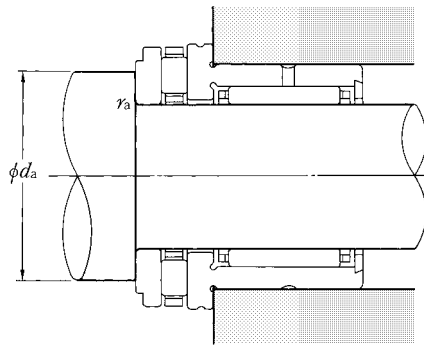
Note 1) Allowable minimum chamfer dimension  $r'$ .

Remarks: Nominal code number of inner ring comprises IR. Bore diameter×outer diameter×width.



| Limiting dimensions<br>r/min |       | Bearing numbers    |                     | Abutment dimensions<br>mm |              |                 |                  | Mass<br>(approx.)<br>kg |                  |
|------------------------------|-------|--------------------|---------------------|---------------------------|--------------|-----------------|------------------|-------------------------|------------------|
| grease                       | oil   | Type NKX+IR        | Type NKX·Z+IR       | $d_a$<br>min              | $d_b$<br>min | $r_{as}$<br>max | $r_{1as}$<br>max | Type<br>NKX+IR          | Type<br>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            |

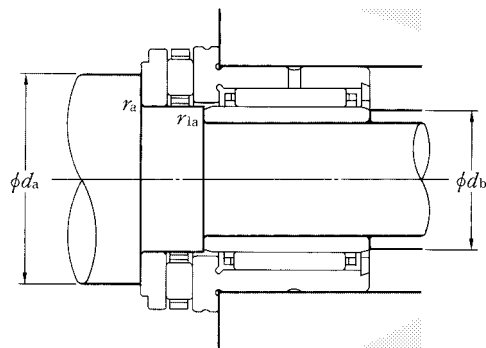




| dynamic | Basic load ratings |         |          | Limiting dimensions |        | Bearing numbers |           | Abutment dimensions |             | Mass<br>(approx.)<br>kg |           |
|---------|--------------------|---------|----------|---------------------|--------|-----------------|-----------|---------------------|-------------|-------------------------|-----------|
|         | static             | dynamic | static   |                     |        |                 |           |                     |             |                         |           |
|         | N                  | kgf     |          | r/min               | grease | oil             | Type NKXR | Type NKXR··Z        | $d_a$<br>mm | $r_{as}$<br>mm          | Type NKXR |
| $C_a$   | $C_{oa}$           | $C_a$   | $C_{oa}$ |                     |        |                 |           | min                 | max         |                         |           |
| 12 900  | 28 600             | 1 310   | 2 920    | 2 800               | 11 000 | NKXR15T2        | NKXR15T2Z | 25                  | 0.3         | 0.048                   | 0.052     |
| 13 400  | 31 000             | 1 370   | 3 150    | 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             | 2 780   | 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     |
| 48 000  | 150 000            | 4 900   | 15 300   | 1 000               | 4 000  | NKXR50T2        | NKXR50T2Z | 66                  | 0.6         | 0.309                   | 0.329     |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
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|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
|         |                    |         |          |                     |        |                 |           |                     |             |                         |           |
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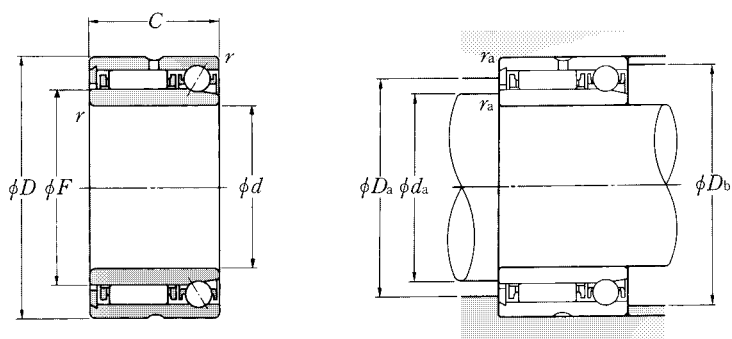






| Limiting dimensions<br>r/min<br>grease oil |        | Bearing numbers     |                      | Abutment dimensions<br>mm |              |                 |                  | Mass<br>(approx.)<br>kg |                    |
|--------------------------------------------|--------|---------------------|----------------------|---------------------------|--------------|-----------------|------------------|-------------------------|--------------------|
|                                            |        | Type NKXR+IR        | Type NKXR··Z+IR      | $d_a$<br>min              | $d_b$<br>min | $r_{as}$<br>max | $r_{1as}$<br>max | Type<br>NKXR+IR         | Type<br>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

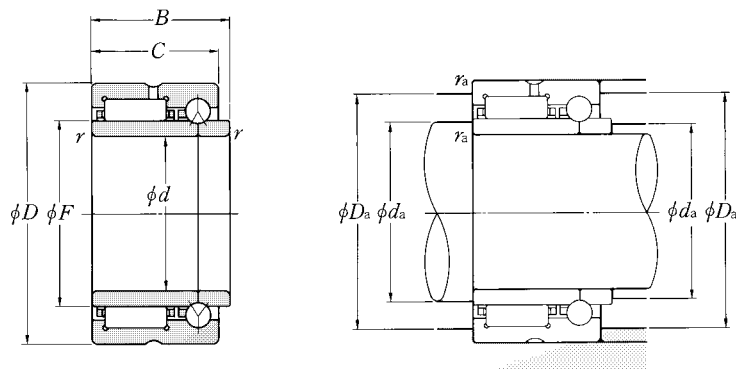
| Boundary dimensions |     |     |     |                   | Basic load ratings |          |         |          |         |          |         |          | Limiting dimensions |        |
|---------------------|-----|-----|-----|-------------------|--------------------|----------|---------|----------|---------|----------|---------|----------|---------------------|--------|
| mm                  |     |     |     |                   | dynamic<br>N       | static   | dynamic | static   | dynamic | static   | dynamic | static   | r/min<br>grease oil |        |
| $d$                 | $D$ | $C$ | $F$ | $r_{s \min}^{1)}$ |                    | Radial   |         |          |         |          | Axial   |          |                     |        |
|                     |     |     |     |                   | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ | $C_a$   | $C_{oa}$ | $C_a$   | $C_{oa}$ |                     |        |
| 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               | 17 400             | 25 000   | 1 770   | 2 550    | 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  $r^*$  or  $r_1$ .

Remarks: This complex can support bi-directional axial load.

| Bearing numbers | Abutment dimensions<br>mm |              |              |                 | Mass<br>kg<br>(approx.) |
|-----------------|---------------------------|--------------|--------------|-----------------|-------------------------|
|                 | $d_a$<br>min              | $D_a$<br>max | $D_b$<br>max | $r_{as}$<br>max |                         |
| NKIA 5902       | 17.5                      | 22           | 25.5         | 0.3             | 0.050                   |
| NKIA 5903       | 19.5                      | 24           | 27.5         | 0.3             | 0.056                   |
| NKIA 5904       | 22.5                      | 28           | 34.5         | 0.3             | 0.111                   |
| NKIA59/22       | 24.5                      | 31           | 36.5         | 0.3             | 0.120                   |
| NKIA 5905       | 27.5                      | 33           | 39.5         | 0.3             | 0.130                   |
| NKIA 5906       | 32.5                      | 38           | 44.5         | 0.3             | 0.147                   |
| NKIA 5907       | 40                        | 45           | 50           | 0.6             | 0.243                   |
| NKIA 5908       | 45                        | 51           | 57           | 0.6             | 0.347                   |
| NKIA 5909       | 50                        | 58           | 63           | 0.6             | 0.401                   |
| NKIA 5910       | 55                        | 63           | 67           | 0.6             | 0.410                   |
| NKIA 5911       | 61                        | 66.5         | 74           | 1               | 0.590                   |
| NKIA 5912       | 66                        | 71.5         | 79           | 1               | 0.632                   |
| NKIA 5913       | 71                        | 78.5         | 84           | 1               | 0.708                   |
| NKIA 5914       | 76                        | 84           | 94           | 1               | 1.05                    |

## Type NKIB 59



$d$  15~70mm

| Boundary dimensions                               |     |     |     |     |                   | Basic load ratings |          |         |          |         |          |         |          | Limiting dimensions |        |
|---------------------------------------------------|-----|-----|-----|-----|-------------------|--------------------|----------|---------|----------|---------|----------|---------|----------|---------------------|--------|
| $d$                                               | $D$ | $B$ | $C$ | $F$ | $r_{s \min}^{1)}$ | dynamic            | static   | dynamic | static   | dynamic | static   | dynamic | static   | grease              | oil    |
| mm                                                |     |     |     |     |                   | N                  |          | kgf     |          | N       |          | kgf     |          | r/min               |        |
| $\begin{smallmatrix} 0 \\ -0.3 \end{smallmatrix}$ |     |     |     |     |                   |                    | Radial   |         |          |         | Axial    |         |          |                     |        |
|                                                   |     |     |     |     |                   | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ | $C_a$   | $C_{oa}$ | $C_a$   | $C_{oa}$ |                     |        |
| 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  $r_s$ .

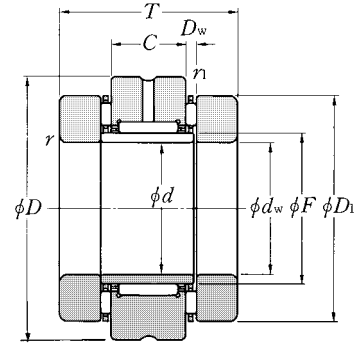
Remarks: 1. This complex can support bi-directional axial load.

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<br>mm |              |                 | Mass<br>kg<br>(approx.) |
|-----------------|---------------------------|--------------|-----------------|-------------------------|
|                 | $d_a$<br>min              | $D_a$<br>max | $r_{as}$<br>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                   |

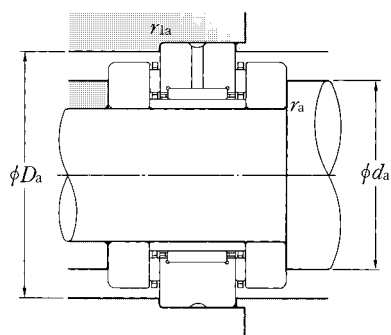
## Type AXN



$d$  20~50mm

| Boundary dimensions |                        |     |                                                        |                                                     |                                                     |     |       |                   |                    | Basic load ratings |          |         |          |         |          |         |          |
|---------------------|------------------------|-----|--------------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|-----|-------|-------------------|--------------------|--------------------|----------|---------|----------|---------|----------|---------|----------|
| $d$                 | $d_w$                  | $D$ | $D_1$                                                  | mm                                                  |                                                     |     |       |                   |                    | dynamic            | static   | dynamic | static   | dynamic | static   | dynamic | static   |
|                     |                        |     |                                                        | $T$                                                 | $C$                                                 | $F$ | $D_w$ | $r_{s \min}^{1)}$ | $r_{ls \min}^{1)}$ | N                  |          | kgf     |          | N       |          | kgf     |          |
|                     |                        |     |                                                        |                                                     |                                                     |     |       |                   |                    | Radial             |          | Radial  |          | Axial   |          | Axial   |          |
|                     |                        |     | $\begin{smallmatrix} -0.20 \\ -0.50 \end{smallmatrix}$ | $\begin{smallmatrix} 0 \\ -0.370 \end{smallmatrix}$ | $\begin{smallmatrix} 0 \\ -0.130 \end{smallmatrix}$ |     |       |                   |                    | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ | $C_a$   | $C_{oa}$ | $C_a$   | $C_{oa}$ |
| 20                  | $20^{+0.061}_{+0.040}$ | 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                  | $25^{+0.061}_{+0.040}$ | 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                  | $30^{+0.061}_{+0.040}$ | 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                  | $35^{+0.075}_{+0.050}$ | 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                  | $40^{+0.075}_{+0.050}$ | 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                  | $45^{+0.075}_{+0.050}$ | 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                  | $50^{+0.075}_{+0.050}$ | 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   |

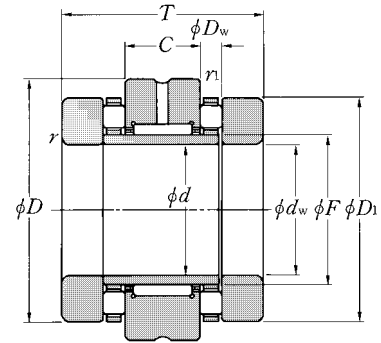
Note 1) Allowable minimum chamfer dimension  $r^*$  or  $r_1$ .



| Limiting dimensions<br>r/min<br>grease oil |       | Bearing numbers | Radial clearance<br>$\mu\text{m}$ |     | Abutment dimensions<br>mm |              |                 |                  | Preload |     | Starting torque <sup>2)</sup> |        | Mass<br>kg<br>(approx.) |
|--------------------------------------------|-------|-----------------|-----------------------------------|-----|---------------------------|--------------|-----------------|------------------|---------|-----|-------------------------------|--------|-------------------------|
|                                            |       |                 |                                   |     |                           |              |                 |                  |         |     |                               |        |                         |
|                                            |       |                 | min                               | max | $d_a$<br>min              | $D_a$<br>max | $r_{as}$<br>max | $r_{las}$<br>max | N       | kgf | N·mm                          | kgf·mm |                         |
| 1 800                                      | 7 000 | AXN2052         | 10                                | 30  | 39                        | 46           | 0.6             | 0.6              | 1 300   | 130 | 330                           | 33     | 0.400                   |
| 1 500                                      | 6 000 | AXN2557         | 10                                | 30  | 44                        | 51           | 0.6             | 0.6              | 1 450   | 145 | 400                           | 40     | 0.520                   |
| 1 400                                      | 5 500 | AXN3062         | 10                                | 40  | 50                        | 56           | 0.6             | 0.6              | 1 600   | 160 | 550                           | 55     | 0.590                   |
| 1 200                                      | 4 700 | AXN3570         | 10                                | 40  | 56                        | 64           | 1               | 0.6              | 2 450   | 245 | 900                           | 90     | 0.800                   |
| 1 100                                      | 4 300 | AXN4075         | 10                                | 40  | 62                        | 69           | 1               | 0.6              | 2 650   | 265 | 1 050                         | 105    | 0.890                   |
| 1 000                                      | 3 900 | AXN4580         | 10                                | 40  | 67                        | 74           | 1               | 0.6              | 2 800   | 280 | 1 200                         | 120    | 1.00                    |
| 900                                        | 3 500 | AXN5090         | 15                                | 50  | 75                        | 83           | 1               | 0.6              | 3 400   | 340 | 1 600                         | 160    | 1.42                    |

Note 2) Starting torque subject to standard preload.

## Type ARN

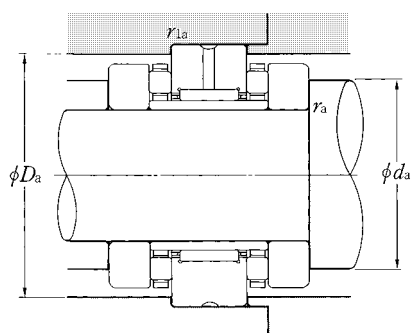


$d$  20~70mm

| Boundary dimensions |                        |     |                                                        |                                                     |                                                     |     |       |                   |                    | Basic load ratings |          |         |          |         |          |         |          |
|---------------------|------------------------|-----|--------------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|-----|-------|-------------------|--------------------|--------------------|----------|---------|----------|---------|----------|---------|----------|
| $d$                 | $d_w$                  | $D$ | $D_1$                                                  | mm                                                  |                                                     |     |       |                   |                    | dynamic            | static   | dynamic | static   | dynamic | static   | dynamic | static   |
|                     |                        |     |                                                        | $T$                                                 | $C$                                                 | $F$ | $D_w$ | $r_{s \min}^{1)}$ | $r_{ls \min}^{1)}$ | N                  |          | kgf     |          | N       |          | kgf     |          |
|                     |                        |     |                                                        |                                                     |                                                     |     |       |                   |                    | Radial             | Radial   | Radial  | Radial   | Axial   | Axial    | Axial   | Axial    |
|                     |                        |     | $\begin{smallmatrix} -0.20 \\ -0.50 \end{smallmatrix}$ | $\begin{smallmatrix} 0 \\ -0.370 \end{smallmatrix}$ | $\begin{smallmatrix} 0 \\ -0.130 \end{smallmatrix}$ |     |       |                   |                    | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ | $C_a$   | $C_{oa}$ | $C_a$   | $C_{oa}$ |
| 20                  | $20^{+0.061}_{+0.040}$ | 52  | 42                                                     | 46                                                  | 16                                                  | 25  | 5     | 0.6               | 0.6                | 15 100             | 22 400   | 1 540   | 2 280    | 27 300  | 68 000   | 2 780   | 6 900    |
| 20                  | $20^{+0.061}_{+0.040}$ | 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                  | $25^{+0.061}_{+0.040}$ | 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                  | $25^{+0.061}_{+0.040}$ | 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                  | $30^{+0.061}_{+0.040}$ | 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                  | $30^{+0.061}_{+0.040}$ | 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                  | $35^{+0.075}_{+0.050}$ | 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                  | $35^{+0.075}_{+0.050}$ | 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                  | $40^{+0.075}_{+0.050}$ | 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                  | $40^{+0.075}_{+0.050}$ | 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                  | $45^{+0.075}_{+0.050}$ | 80  | 70                                                     | 60                                                  | 25                                                  | 50  | 6     | 1                 | 0.6                | 38 500             | 74 500   | 3 950   | 7 550    | 48 000  | 150 000  | 4 900   | 15 300   |
| 45                  | $45^{+0.075}_{+0.050}$ | 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                  | $50^{+0.075}_{+0.050}$ | 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                  | $50^{+0.075}_{+0.050}$ | 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                  | $55^{+0.090}_{+0.060}$ | 115 | 100                                                    | 82                                                  | 25                                                  | 65  | 11    | 1.1               | 0.6                | 44 500             | 98 000   | 4 550   | 10 000   | 130 000 | 385 000  | 13 200  | 39 500   |
| 60                  | $60^{+0.090}_{+0.060}$ | 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                  | $65^{+0.090}_{+0.060}$ | 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                  | $70^{+0.090}_{+0.060}$ | 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  $r_1$ .





| Limiting dimensions<br>r/min<br>grease oil |       | Bearing numbers | Radial clearance<br>$\mu\text{m}$ |     | Abutment dimensions<br>mm |              |                 |                  | Preload |       | Starting torque <sup>2)</sup> |        | Mass<br>kg<br>(approx.) |
|--------------------------------------------|-------|-----------------|-----------------------------------|-----|---------------------------|--------------|-----------------|------------------|---------|-------|-------------------------------|--------|-------------------------|
|                                            |       |                 |                                   |     |                           |              |                 |                  |         |       |                               |        |                         |
|                                            |       |                 | min                               | max | $d_a$<br>min              | $D_a$<br>max | $r_{as}$<br>max | $r_{las}$<br>max | N       | kgf   | N·mm                          | kgf·mm |                         |
| 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) Starting torque subject to standard preload.



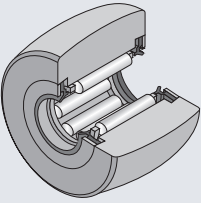
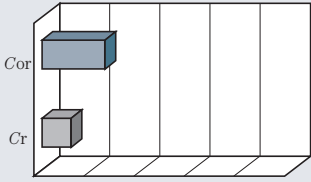
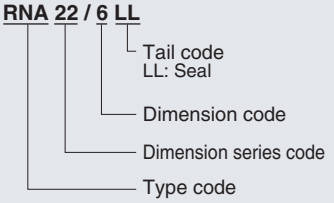
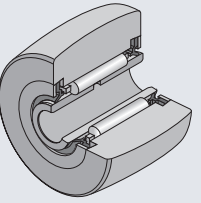
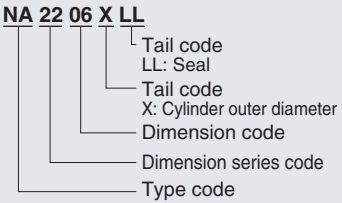
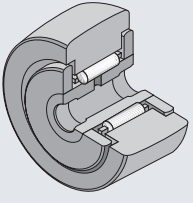
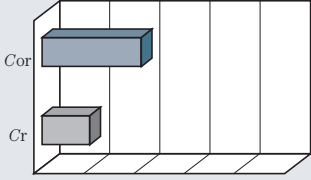
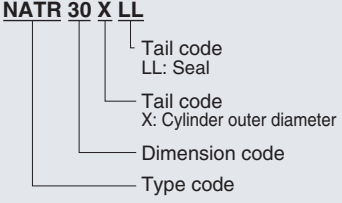
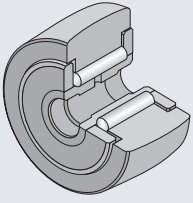
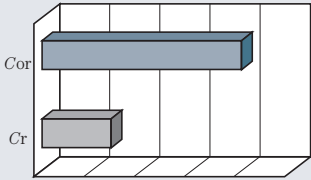
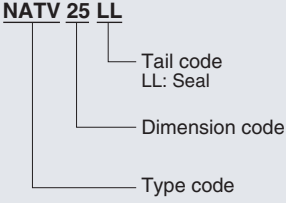
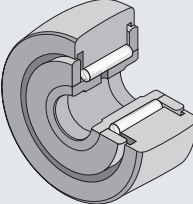
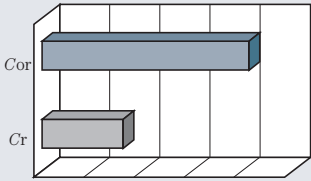
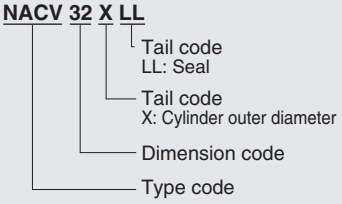
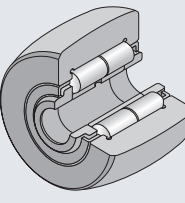
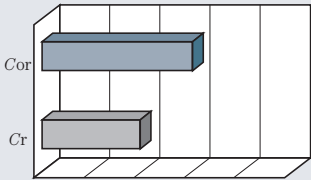
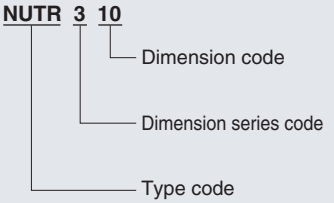
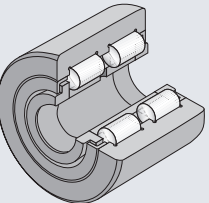
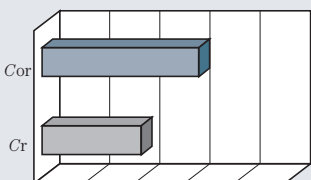
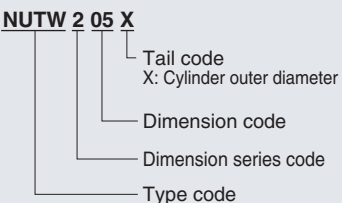
# Roller Followers / Cam Followers



## Roller Followers (Yoke Type Track Rollers)

NTN Yoke Type Track Rollers is 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 such a wall thickness as to be resistible to high load and shock load.

Both of spherical outer surface (rolling surface) and cylindrical outer surface are available for the outer ring. The spherical outer ring can damp 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                                                                                       | Applied shaft diameter (mm) | Load capacity                                                                        | Composition of nominal bearing number                                                                        |
|----------------------------------------------------------------------------------------------------|-----------------------------|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| <b>RNA22</b><br>  | $\phi 6 \sim \phi 58$       |    | <b>RNA 22 / 6 LL</b><br>  |
| <b>NA22</b><br>   |                             |                                                                                      | <b>NA 22 06 X LL</b><br>  |
| <b>NATR</b><br> | $\phi 5 \sim \phi 50$       |  | <b>NATR 30 X LL</b><br> |
| <b>NATV</b><br> | $\phi 5 \sim \phi 50$       |  | <b>NATV 25 LL</b><br>   |
| <b>NACV</b><br> | $\phi 6.35 \sim \phi 57.15$ |  | <b>NACV 32 X LL</b><br> |
| <b>NUTR</b><br> | $\phi 15 \sim \phi 50$      |  | <b>NUTR 3 10</b><br>    |
| <b>NUTW</b><br> | $\phi 15 \sim \phi 50$      |  | <b>NUTW 2 05 X</b><br>  |

Each listed load capacity is subject to reference bearing bore diameter of  $\phi 50$  or  $\phi 50.8$

| Track roller components                                                                                                                                       | Features                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Inscribed circle diameter : $\phi 6$<br>Type with cage<br>Inner ring : without<br>Outer profile : spherical<br>Seal : with                                    | <ul style="list-style-type: none"> <li>• The needle rollers and the cage are retained in the outer ring with a steel plate reinforced synthetic rubber seal, and these are inseparable from each other.</li> <li>• The needle rollers guided by cage.</li> <li>• Shaft (Pin) must be provided with a thrust washer or a flange to guide the outer ring.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Inscribed circle diameter : $\phi 30$<br>Type with cage<br>Inner ring : with<br>Outer profile : cylindrical<br>Seal : with                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Inscribed circle diameter : $\phi 30$<br>Type with cage<br>Outer profile : cylindrical<br>Seal : with                                                         | <ul style="list-style-type: none"> <li>• Needle rollers guided by cage.</li> <li>• The outer ring is guided in axial direction by the thrust washer press-fitted in the inner ring.</li> <li>• Labyrinth is formed between the outer ring and the thrust washer.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Inscribed circle diameter : $\phi 30$<br>Full complement roller type<br>Outer profile : cylindrical<br>Seal : with                                            | <ul style="list-style-type: none"> <li>• The outer ring is guided in axial direction by the thrust washer press-fitted in the inner ring.</li> <li>• Great rated load due to the full complement roller type.</li> <li>• Lower allowable running speed than bearing with cage.</li> <li>• Labyrinth is formed between the outer ring and the thrust washer.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Inscribed circle diameter : $\phi 15.875$<br>Full complement roller type<br>Outer profile : cylindrical<br>Seal : with                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Inscribed circle diameter : $\phi 50$<br>Double-row cylindrical<br>Full-complement roller type<br>Labyrinth seal<br>Outer profile : spherical                 | <ul style="list-style-type: none"> <li>• Greater rated load, best-suited to applications subjected to high load and shock load.</li> <li>• A steel plate is press-fitted in the outer ring to form labyrinth between the plate and the side plates at both sides of the inner ring, whereby the required sealing performance is secured and the side plates are held so as not to separate from one another.</li> <li>• The inner ring and the side plates are tightened together in axial direction for non-clearance.</li> <li>• The outer ring is guided in axial direction by the outer ring ribs and the end faces of cylindrical roller.</li> </ul> <p>Particularly Type NUTW provides the following features.</p> <ul style="list-style-type: none"> <li>• The greatest rated load, of the roller followers.</li> <li>• Due to the outer ring with inner ribs, this type is excellently resistible to axial load and moment load and, in addition, runs smoothly, though depending on actual operating conditions.</li> <li>• Good lubrication effect and longer life are expectable by increasing the grease fill volume.</li> </ul> |
| Inscribed circle diameter : $\phi 25$<br>Double-row cylindrical<br>Full-complement roller type with center rib<br>Labyrinth seal<br>Outer profile : spherical |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

## Bearing Tolerances

The respective dimensional accuracy, profile accuracy and running accuracy of the bearing bore diameter ( $d$ ), cylindrical roller outer diameter ( $D$ ), and outer ring width ( $C$ ) are as shown in **Table 4.3** of Section 4. "**Bearing Accuracy**" (page A-26). (Conforming to JIS Accuracy Class-0)

On the other hand, the dimensional tolerances for spherical roller outer diameter ( $D$ ) and the roller inscribed circle diameter ( $F_w$ ) of **Type RNA22** are as shown in applicable Dimensions Table.

## Bearing fits and radial clearance

The tolerance range class of shaft against bearing with inner ring shall be g6 (h6) and, where a shaft is used as the direct raceway surface (**Type RNA22**), the tolerance range class of the shaft shall be k5 (k6). In general, the outer ring is not fitted in a housing. Mounting relations

**Table 1 Radial clearances**

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 |

- (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.

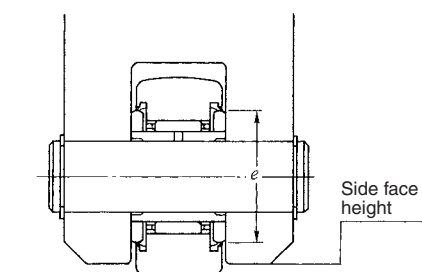


**Fig.1**

- (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.

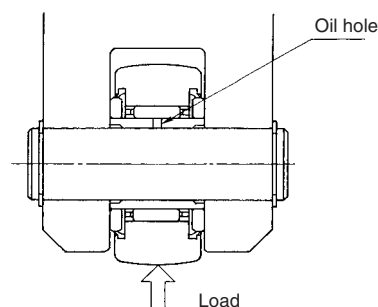


**Fig.2**

- (3) **Type NA··22LL** and **RNA22** are of separable type and, hence, the outer ring is guided by flange or thrust washer mounted on shaft (pin). Therefore, the guide surface must be finished more precisely than by lathe-turning and deburred completely for surface 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.

$$A \geq \frac{1}{2}(D+e)$$

For  $D$  and  $e$  dimensions refer to applicable Dimensions Table.

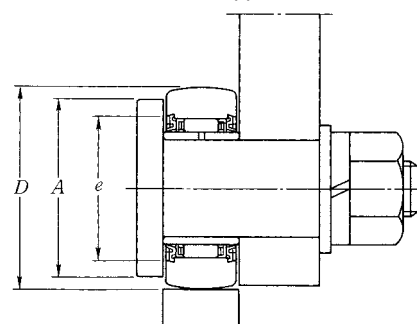


**Fig.3**

In assembling this bearing, it must be handled with good care to protect the seal lip from bending and flaw.

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 roller followers with synthetic rubber seal (with tail code : **LL**) and the full complement roller type followers are filled up with lithium soap base grease so that they can be used in the temperature range of -25 to +100°C. 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**.

**The outer ring outer surface of bearing and the track surface must both be lubricated. Failure to lubricate could result earlier in damage of the bearing.**

## Track load capacity

Statically allowable maximum radial load on the contact surface of track to track roller is referred to as "track load capacity", which differs depending on the track hardness. The track load capacity described in applicable Dimensions Table is subject to track hardness HRC40. If the hardness value is other than HRC40, multiply the track load capacity in the Dimensions Table by the adjustment factor  $G$  in **Table 2**, for determining the track load capacity. However, the track load capacity shall be  $C_{0r}$  if the calculated track load capacity exceeds the basic static load rating  $C_{0r}$  of bearing.

Refer to page A-55 for the detail.

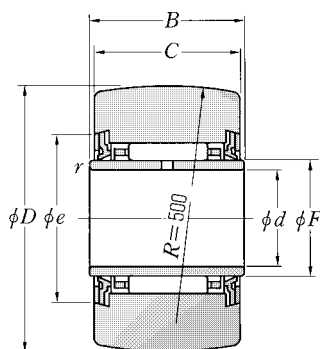
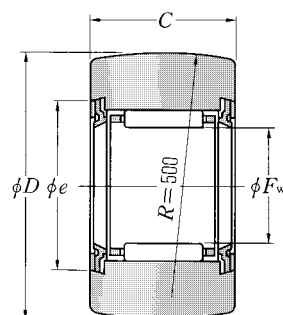
**Table 2 Adjustment factor  $G$**

| Hardness<br>HRC | Adjustment factor $G$ |                   |
|-----------------|-----------------------|-------------------|
|                 | Cylindrical surface   | Spherical surface |
| 20              | 0.37                  | 0.22              |
| 25              | 0.46                  | 0.31              |
| 30              | 0.58                  | 0.45              |
| 35              | 0.75                  | 0.65              |
| 40              | 1.00                  | 1.00              |
| 45              | 1.40                  | 1.70              |
| 50              | 2.00                  | 2.80              |
| 55              | 2.80                  | 4.70              |

## Metric series

Type NA22··LL

Type RNA22··LL

Type NA22··LL  
(With inner ring)Type RNA22··LL  
(Without inner ring)

D 19~90mm

| Boundary dimensions |    |      |    |                |                  |    |    |                    | Basic load ratings |                 |                |                 | Load ratings of truck |        |       |       |
|---------------------|----|------|----|----------------|------------------|----|----|--------------------|--------------------|-----------------|----------------|-----------------|-----------------------|--------|-------|-------|
| D<br>0<br>-0.05     | B  | C    | d  | mm             |                  | e  | F  | r <sup>1)</sup> mm | dynamic            | static          | dynamic        | static          | N                     |        | kgf   |       |
|                     |    |      |    | F <sub>w</sub> |                  |    |    |                    | N                  |                 | kgf            |                 |                       |        |       |       |
|                     |    |      |    |                |                  |    |    |                    | C <sub>r</sub>     | C <sub>or</sub> | C <sub>r</sub> | C <sub>or</sub> |                       |        |       |       |
| 19                  | 12 | 11.8 | 6  | 10             | +0.022<br>+0.013 | 16 | 10 | 0.3                | 4 550              | 4 250           | 460            | 435             | 1 380                 | 4 400  | 141   | 445   |
| 24                  | 12 | 11.8 | 8  | 12             | +0.027<br>+0.016 | 18 | 12 | 0.3                | 5 150              | 5 250           | 525            | 535             | 1 900                 | 5 500  | 193   | 565   |
| 30                  | 14 | 13.8 | 10 | 14             | +0.027<br>+0.016 | 20 | 14 | 0.3                | 7 550              | 9 000           | 770            | 915             | 2 620                 | 7 550  | 267   | 770   |
| 32                  | 14 | 13.8 | 12 | 16             | +0.027<br>+0.016 | 22 | 16 | 0.3                | 8 100              | 10 300          | 830            | 1 050           | 2 860                 | 8 050  | 291   | 820   |
| 35                  | 14 | 13.8 | 15 | 20             | +0.033<br>+0.020 | 26 | 20 | 0.3                | 9 850              | 14 100          | 1 010          | 1 440           | 3 200                 | 8 800  | 325   | 900   |
| 40                  | 16 | 15.8 | 17 | 22             | +0.033<br>+0.020 | 28 | 22 | 0.3                | 10 400             | 15 600          | 1 060          | 1 590           | 3 850                 | 10 900 | 390   | 1 110 |
| 47                  | 18 | 17.8 | 20 | 25             | +0.033<br>+0.020 | 33 | 25 | 0.3                | 16 900             | 22 900          | 1 730          | 2 340           | 4 700                 | 14 800 | 480   | 1 510 |
| 52                  | 18 | 17.8 | 25 | 30             | +0.033<br>+0.020 | 38 | 30 | 0.3                | 17 900             | 25 900          | 1 820          | 2 640           | 5 550                 | 16 400 | 565   | 1 670 |
| 62                  | 20 | 19.8 | 30 | 35             | +0.041<br>+0.025 | 43 | 35 | 0.3                | 21 400             | 34 500          | 2 190          | 3 500           | 6 950                 | 22 200 | 710   | 2 260 |
| 72                  | 23 | 22.7 | 35 | 42             | +0.041<br>+0.025 | 50 | 42 | 0.6                | 26 300             | 47 500          | 2 690          | 4 850           | 8 050                 | 28 700 | 820   | 2 930 |
| 80                  | 23 | 22.7 | 40 | 48             | +0.041<br>+0.025 | 57 | 48 | 0.6                | 28 400             | 55 000          | 2 900          | 5 600           | 9 800                 | 32 000 | 1 000 | 3 250 |
| 85                  | 23 | 22.7 | 45 | 52             | +0.049<br>+0.030 | 62 | 52 | 0.6                | 29 300             | 58 500          | 2 990          | 5 950           | 10 400                | 34 000 | 1 060 | 3 450 |
| 90                  | 23 | 22.7 | 50 | 58             | +0.049<br>+0.030 | 68 | 58 | 0.6                | 31 000             | 66 000          | 3 200          | 6 700           | 11 400                | 36 000 | 1 160 | 3 650 |

Note 1) Allowable minimum chamfer dimension r.

2) For bearing with cylindrical outer surface, the nominal bearing is followed by "X". In this case, the bearing is manufactured with outer ring diameter tolerance conforming to JIS Class-0. Ex. NA2203XLL



| Limiting<br>speeds<br>r/min<br>grease | Bearing numbers                |                                 | Mass<br>(approx.)<br>kg |                   |
|---------------------------------------|--------------------------------|---------------------------------|-------------------------|-------------------|
|                                       | Type<br>NA22··LL <sup>2)</sup> | Type<br>RNA22··LL <sup>2)</sup> | Type<br>NA22··LL        | Type<br>RNA22··LL |
| 10 000                                | NA22/6LL                       | RNA22/6LL                       | 0.023                   | 0.018             |
| 10 000                                | NA22/8LL                       | RNA22/8LL                       | 0.035                   | 0.027             |
| 10 000                                | NA2200LL                       | RNA2200LL                       | 0.060                   | 0.052             |
| 9 500                                 | NA2201LL                       | RNA2201LL                       | 0.067                   | 0.057             |
| 7 500                                 | NA2202LL                       | RNA2202LL                       | 0.075                   | 0.060             |
| 7 000                                 | NA2203LL                       | RNA2203LL                       | 0.113                   | 0.094             |
| 6 000                                 | NA2204LL                       | RNA2204LL                       | 0.176                   | 0.152             |
| 5 000                                 | NA2205LL                       | RNA2205LL                       | 0.209                   | 0.179             |
| 4 300                                 | NA2206LL                       | RNA2206LL                       | 0.322                   | 0.284             |
| 3 600                                 | NA2207LL                       | RNA2207LL                       | 0.506                   | 0.432             |
| 3 100                                 | NA2208LL                       | RNA2208LL                       | 0.623                   | 0.530             |
| 2 900                                 | NA2209LL                       | RNA2209LL                       | 0.638                   | 0.545             |
| 2 600                                 | NA2210LL                       | RNA2210LL                       | 0.682                   | 0.563             |

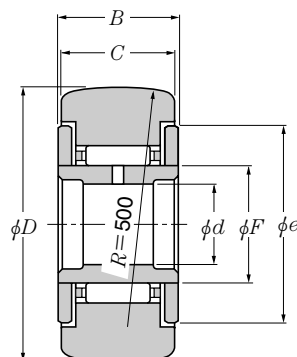
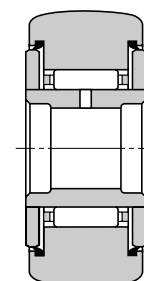
## Metric series

Type NATR

Type NATR··LL

Type NATV

Type NATV··LL

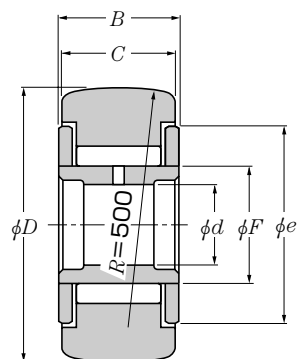
Type NATR  
(With cage)Type NATR··LL  
(Sealed type with cage)

D 16~90mm

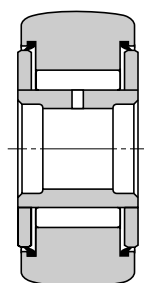
| Boundary dimensions                                |                      |         |    |    |                | Basic load ratings |                 |                |                 | Load ratings of truck |        |       |       | Limiting speeds |         |
|----------------------------------------------------|----------------------|---------|----|----|----------------|--------------------|-----------------|----------------|-----------------|-----------------------|--------|-------|-------|-----------------|---------|
| D                                                  | B                    | mm<br>C | d  | e  | F <sub>w</sub> | dynamic<br>N       | static<br>N     | dynamic<br>kgf | static<br>kgf   | N                     |        | kgf   |       | r/min<br>grease | oil     |
| $\begin{smallmatrix} 0 \\ -0.05 \end{smallmatrix}$ |                      |         |    |    |                | C <sub>r</sub>     | C <sub>or</sub> | C <sub>r</sub> | C <sub>or</sub> |                       |        |       |       |                 |         |
| 16                                                 | 12 <sub>0</sub>      | 11      | 5  | 12 | 8              | 4 050              | 4 200           | 415            | 430             | 1 080                 | 3 400  | 110   | 350   | ※19 000         | ※25 000 |
|                                                    | 12 <sup>-0.180</sup> | 11      | 5  | 12 | 8              | 6 500              | 9 350           | 665            | 955             | 1 080                 | 3 400  | 110   | 350   | ※13 000         | ※16 000 |
| 19                                                 | 12 <sub>0</sub>      | 11      | 6  | 14 | 10             | 4 750              | 5 400           | 480            | 555             | 1 380                 | 4 050  | 141   | 415   | ※15 000         | ※20 000 |
|                                                    | 12 <sup>-0.180</sup> | 11      | 6  | 14 | 10             | 7 450              | 11 700          | 760            | 1 190           | 1 380                 | 4 050  | 141   | 415   | 10 000          | ※13 000 |
| 24                                                 | 15 <sub>0</sub>      | 14      | 8  | 19 | 12             | 6 900              | 7 700           | 705            | 785             | 1 900                 | 6 650  | 193   | 680   | ※12 000         | ※16 000 |
|                                                    | 15 <sup>-0.180</sup> | 14      | 8  | 19 | 12             | 10 700             | 16 200          | 1 090          | 1 650           | 1 900                 | 6 650  | 193   | 680   | 8 500           | ※11 000 |
| 30                                                 | 15 <sub>0</sub>      | 14      | 10 | 23 | 15             | 7 850              | 9 650           | 800            | 985             | 2 620                 | 7 700  | 267   | 785   | 10 000          | ※13 000 |
|                                                    | 15 <sup>-0.180</sup> | 14      | 10 | 23 | 15             | 12 000             | 20 300          | 1 230          | 2 070           | 2 620                 | 7 700  | 267   | 785   | 6 500           | 8 500   |
| 32                                                 | 15 <sub>0</sub>      | 14      | 12 | 25 | 17             | 8 850              | 11 700          | 900            | 1 190           | 2 860                 | 8 200  | 291   | 835   | 9 000           | ※12 000 |
|                                                    | 15 <sup>-0.180</sup> | 14      | 12 | 25 | 17             | 13 000             | 23 000          | 1 330          | 2 350           | 2 860                 | 8 200  | 291   | 835   | 6 000           | 7 500   |
| 35                                                 | 19 <sub>0</sub>      | 18      | 15 | 27 | 20             | 13 300             | 20 800          | 1 360          | 2 120           | 3 200                 | 11 900 | 325   | 1 220 | 7 500           | 10 000  |
|                                                    | 19 <sup>-0.210</sup> | 18      | 15 | 27 | 20             | 18 400             | 38 000          | 1 870          | 3 900           | 3 200                 | 11 900 | 325   | 1 220 | 5 000           | 6 500   |
| 40                                                 | 21 <sub>0</sub>      | 20      | 17 | 32 | 22             | 14 000             | 22 800          | 1 430          | 2 330           | 3 850                 | 14 500 | 390   | 1 480 | 7 000           | 9 000   |
|                                                    | 21 <sup>-0.210</sup> | 20      | 17 | 32 | 22             | 19 400             | 42 000          | 1 980          | 4 250           | 3 850                 | 14 500 | 390   | 1 480 | 4 500           | 6 000   |
| 47                                                 | 25 <sub>0</sub>      | 24      | 20 | 37 | 25             | 20 700             | 33 500          | 2 110          | 3 450           | 4 700                 | 21 000 | 480   | 2 150 | 6 000           | 8 000   |
|                                                    | 25 <sup>-0.210</sup> | 24      | 20 | 37 | 25             | 28 800             | 61 000          | 2 940          | 6 250           | 4 700                 | 21 000 | 480   | 2 150 | 4 000           | 5 000   |
| 52                                                 | 25 <sub>0</sub>      | 24      | 25 | 42 | 30             | 22 800             | 40 500          | 2 320          | 4 100           | 5 500                 | 23 300 | 565   | 2 370 | 5 000           | 6 500   |
|                                                    | 25 <sup>-0.210</sup> | 24      | 25 | 42 | 30             | 31 500             | 73 500          | 3 200          | 7 500           | 5 500                 | 23 300 | 565   | 2 370 | 3 300           | 4 500   |
| 62                                                 | 29 <sub>0</sub>      | 28      | 30 | 51 | 38             | 36 000             | 66 000          | 3 650          | 6 750           | 6 950                 | 33 000 | 710   | 3 350 | 4 000           | 5 500   |
|                                                    | 29 <sup>-0.210</sup> | 28      | 30 | 51 | 38             | 47 500             | 115 000         | 4 850          | 11 700          | 6 950                 | 33 000 | 710   | 3 350 | 2 600           | 3 500   |
| 72                                                 | 29 <sub>0</sub>      | 28      | 35 | 58 | 44.5           | 39 000             | 77 000          | 3 950          | 7 850           | 8 050                 | 37 000 | 820   | 3 750 | 3 300           | 4 500   |
|                                                    | 29 <sup>-0.210</sup> | 28      | 35 | 58 | 44.5           | 52 000             | 134 000         | 5 300          | 13 600          | 8 050                 | 37 000 | 820   | 3 750 | 2 200           | 2 900   |
| 80                                                 | 32 <sub>0</sub>      | 30      | 40 | 66 | 50             | 49 500             | 92 500          | 5 050          | 9 400           | 9 800                 | 44 500 | 1 000 | 4 500 | 3 000           | 4 000   |
|                                                    | 32 <sup>-0.250</sup> | 30      | 40 | 66 | 50             | 68 500             | 171 000         | 7 000          | 17 500          | 9 800                 | 44 500 | 1 000 | 4 500 | 2 000           | 2 600   |
| 85                                                 | 32 <sub>0</sub>      | 30      | 45 | 71 | 55             | 51 500             | 100 000         | 5 250          | 10 200          | 10 400                | 47 000 | 1 060 | 4 800 | 2 700           | 3 600   |
| 90                                                 | 32 <sub>0</sub>      | 30      | 50 | 76 | 60             | 53 000             | 108 000         | 5 450          | 11 000          | 11 400                | 50 000 | 1 160 | 5 100 | 2 500           | 3 300   |
|                                                    | 32 <sup>-0.250</sup> | 30      | 50 | 76 | 60             | 76 000             | 205 000         | 7 750          | 20 900          | 11 400                | 50 000 | 1 160 | 5 100 | 1 600           | 2 100   |

Note 1) For bearing with cylindrical outer surface, the nominal bearing is followed by "X". In this case, the bearing is manufactured with outer ring diameter tolerance conforming to JIS Class-0. Ex. NATR5X

Remarks: For the follower with seal, the maximum revolutions is allowable up to 10 000 r/min.



**Type NATV**  
(Full complement type)



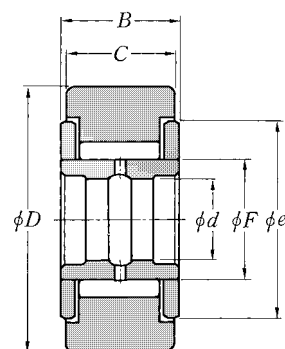
**Type NATV··LL**  
(Full complement type with seals)

| Bearing numbers <sup>1)</sup> |               | Mass      |
|-------------------------------|---------------|-----------|
| Type NATR                     | Type NATR··LL | kg        |
| Type NATV                     | Type NATV··LL | (approx.) |
| NATR5                         | NATR5LL       | 0.018     |
| NATV5                         | NATV5LL       | 0.020     |
| NATR6                         | NATR6LL       | 0.025     |
| NATV6                         | NATV6LL       | 0.027     |
| NATR8                         | NATR8LL       | 0.042     |
| NATV8                         | NATV8LL       | 0.044     |
| NATR10                        | NATR10LL      | 0.061     |
| NATV10                        | NATV10LL      | 0.065     |
| NATR12                        | NATR12LL      | 0.069     |
| NATV12                        | NATV12LL      | 0.074     |
| NATR15                        | NATR15LL      | 0.098     |
| NATV15                        | NATV15LL      | 0.102     |
| NATR17                        | NATR17LL      | 0.140     |
| NATV17                        | NATV17LL      | 0.145     |
| NATR20                        | NATR20LL      | 0.246     |
| NATV20                        | NATV20LL      | 0.254     |
| NATR25                        | NATR25LL      | 0.275     |
| NATV25                        | NATV25LL      | 0.285     |
| NATR30                        | NATR30LL      | 0.470     |
| NATV30                        | NATV30LL      | 0.481     |
| NATR35                        | NATR35LL      | 0.635     |
| NATV35                        | NATV35LL      | 0.647     |
| NATR40                        | NATR40LL      | 0.875     |
| NATV40                        | NATV40LL      | 0.890     |
| NATR45                        | NATR45LL      | 0.910     |
| NATR50                        | NATR50LL      | 0.960     |
| NATV50                        | NATV50LL      | 0.990     |

## Inch series

Type NACV···X

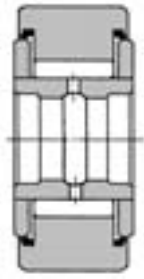
Type NACV···XLL

Type NACV···X  
(Full complement)

D 19.050~152.400mm

| Boundary dimensions                                 |                                                     |                                                     |                          |                                                          |                |       | Basic load ratings |                 |                |                 |
|-----------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|--------------------------|----------------------------------------------------------|----------------|-------|--------------------|-----------------|----------------|-----------------|
| D                                                   | B                                                   | C                                                   | d                        | e                                                        | F <sub>w</sub> |       | dynamic            | static          | dynamic        | static          |
| $\begin{smallmatrix} 0 \\ -0.025 \end{smallmatrix}$ | $\begin{smallmatrix} 0 \\ -0.250 \end{smallmatrix}$ | $\begin{smallmatrix} 0 \\ -0.130 \end{smallmatrix}$ |                          |                                                          |                |       | N                  |                 | kgf            |                 |
|                                                     |                                                     | mm ( $\frac{1}{25.4}$ mm)                           |                          |                                                          |                |       | C <sub>r</sub>     | C <sub>or</sub> | C <sub>r</sub> | C <sub>or</sub> |
| 19.050( $\frac{3}{4}$ )                             | 14.288( $\frac{9}{16}$ )                            | 12.700( $\frac{1}{2}$ )                             | 6.350( $\frac{1}{4}$ )   | $\begin{smallmatrix} +0.005 \\ -0.010 \end{smallmatrix}$ | 15.5           | 11    | 8 050              | 13 300          | 825            | 1 360           |
| 22.225( $\frac{7}{8}$ )                             | 14.288( $\frac{9}{16}$ )                            | 12.700( $\frac{1}{2}$ )                             | 6.350( $\frac{1}{4}$ )   | $\begin{smallmatrix} +0.005 \\ -0.010 \end{smallmatrix}$ | 15.5           | 11    | 8 050              | 13 300          | 825            | 1 360           |
| 25.400(1)                                           | 17.462( $\frac{11}{16}$ )                           | 15.875( $\frac{5}{8}$ )                             | 7.938( $\frac{5}{16}$ )  | $\begin{smallmatrix} +0.005 \\ -0.010 \end{smallmatrix}$ | 19.5           | 14    | 11 700             | 18 900          | 1 190          | 1 920           |
| 28.575(1 $\frac{1}{8}$ )                            | 17.462( $\frac{11}{16}$ )                           | 15.875( $\frac{5}{8}$ )                             | 7.938( $\frac{5}{16}$ )  | $\begin{smallmatrix} +0.005 \\ -0.010 \end{smallmatrix}$ | 19.5           | 14    | 11 700             | 18 900          | 1 190          | 1 920           |
| 31.750(1 $\frac{1}{4}$ )                            | 20.638( $\frac{13}{16}$ )                           | 19.050( $\frac{3}{4}$ )                             | 9.525( $\frac{3}{8}$ )   | $\begin{smallmatrix} +0.005 \\ -0.010 \end{smallmatrix}$ | 25             | 18.47 | 17 700             | 35 000          | 1 810          | 3 600           |
| 34.925(1 $\frac{3}{8}$ )                            | 20.638( $\frac{13}{16}$ )                           | 19.050( $\frac{3}{4}$ )                             | 9.525( $\frac{3}{8}$ )   | $\begin{smallmatrix} +0.005 \\ -0.010 \end{smallmatrix}$ | 25             | 18.47 | 17 700             | 35 000          | 1 810          | 3 600           |
| 38.100(1 $\frac{1}{2}$ )                            | 23.812( $\frac{15}{16}$ )                           | 22.225( $\frac{7}{8}$ )                             | 11.112( $\frac{7}{16}$ ) | $\begin{smallmatrix} +0.005 \\ -0.010 \end{smallmatrix}$ | 27             | 21    | 21 100             | 45 500          | 2 150          | 4 650           |
| 41.275(1 $\frac{5}{8}$ )                            | 23.812( $\frac{15}{16}$ )                           | 22.225( $\frac{7}{8}$ )                             | 11.112( $\frac{7}{16}$ ) | $\begin{smallmatrix} +0.005 \\ -0.010 \end{smallmatrix}$ | 27             | 21    | 21 100             | 45 500          | 2 150          | 4 650           |
| 44.450(1 $\frac{3}{4}$ )                            | 26.988(1 $\frac{1}{16}$ )                           | 25.400(1)                                           | 12.700( $\frac{1}{2}$ )  | $\begin{smallmatrix} +0.005 \\ -0.010 \end{smallmatrix}$ | 31.5           | 24.65 | 28 400             | 60 500          | 2 900          | 6 150           |
| 47.625(1 $\frac{7}{8}$ )                            | 26.988(1 $\frac{1}{16}$ )                           | 25.400(1)                                           | 12.700( $\frac{1}{2}$ )  | $\begin{smallmatrix} +0.005 \\ -0.010 \end{smallmatrix}$ | 31.5           | 24.65 | 28 400             | 60 500          | 2 900          | 6 150           |
| 50.800(2)                                           | 33.338(1 $\frac{5}{16}$ )                           | 31.750(1 $\frac{1}{4}$ )                            | 15.875( $\frac{5}{8}$ )  | $\begin{smallmatrix} +0.005 \\ -0.010 \end{smallmatrix}$ | 36.5           | 26.71 | 41 000             | 87 500          | 4 200          | 8 950           |
| 57.150(2 $\frac{1}{4}$ )                            | 33.338(1 $\frac{5}{16}$ )                           | 31.750(1 $\frac{1}{4}$ )                            | 15.875( $\frac{5}{8}$ )  | $\begin{smallmatrix} +0.005 \\ -0.010 \end{smallmatrix}$ | 36.5           | 26.71 | 41 000             | 87 500          | 4 200          | 8 950           |
| 63.500(2 $\frac{1}{2}$ )                            | 39.688(1 $\frac{9}{16}$ )                           | 38.100(1 $\frac{1}{2}$ )                            | 19.050( $\frac{3}{4}$ )  | $\begin{smallmatrix} +0.005 \\ -0.010 \end{smallmatrix}$ | 44             | 31.15 | 54 500             | 119 000         | 5 600          | 12 200          |
| 69.850(2 $\frac{3}{4}$ )                            | 39.688(1 $\frac{9}{16}$ )                           | 38.100(1 $\frac{1}{2}$ )                            | 19.050( $\frac{3}{4}$ )  | $\begin{smallmatrix} +0.005 \\ -0.010 \end{smallmatrix}$ | 44             | 31.15 | 54 500             | 119 000         | 5 600          | 12 200          |
| 76.200(3)                                           | 46.038(1 $\frac{13}{16}$ )                          | 44.450(1 $\frac{3}{4}$ )                            | 25.400(1)                | $\begin{smallmatrix} +0.002 \\ -0.013 \end{smallmatrix}$ | 53             | 36.85 | 76 500             | 177 000         | 7 800          | 18 000          |
| 82.550(3 $\frac{1}{4}$ )                            | 46.038(1 $\frac{13}{16}$ )                          | 44.450(1 $\frac{3}{4}$ )                            | 25.400(1)                | $\begin{smallmatrix} +0.002 \\ -0.013 \end{smallmatrix}$ | 53             | 36.85 | 76 500             | 177 000         | 7 800          | 18 000          |
| 88.900(3 $\frac{1}{2}$ )                            | 52.388(2 $\frac{1}{16}$ )                           | 50.800(2)                                           | 28.575(1 $\frac{1}{8}$ ) | $\begin{smallmatrix} +0.002 \\ -0.013 \end{smallmatrix}$ | 60             | 44.5  | 84 500             | 214 000         | 8 650          | 21 800          |
| 101.600(4)                                          | 58.738(2 $\frac{5}{16}$ )                           | 57.150(2 $\frac{1}{4}$ )                            | 31.750(1 $\frac{1}{4}$ ) | $\begin{smallmatrix} +0.002 \\ -0.013 \end{smallmatrix}$ | 63             | 44.5  | 106 000            | 244 000         | 10 800         | 24 900          |
| 127.000(5)                                          | 73.025(2 $\frac{7}{8}$ )                            | 69.850(2 $\frac{3}{4}$ )                            | 44.450(1 $\frac{3}{4}$ ) | $\begin{smallmatrix} +0.002 \\ -0.013 \end{smallmatrix}$ | 89             | 68.7  | 189 000            | 520 000         | 19 300         | 53 000          |
| 152.400(6)                                          | 85.725(3 $\frac{3}{8}$ )                            | 82.550(3 $\frac{1}{4}$ )                            | 57.150(2 $\frac{1}{4}$ ) | $\begin{smallmatrix} +0.002 \\ -0.013 \end{smallmatrix}$ | 110            | 81.35 | 260 000            | 675 000         | 26 500         | 68 500          |

Note 1) For the bearing with spherical outer surface, "X" symbol shall be deleted from the Nominal number. In this case, spherical bearing (R=500) is manufactured with tolerance 0/-0.05 against the outer ring outer diameter "D". Ex. NACV12



**Type NACV··XLL**  
(Full complement sealed type)

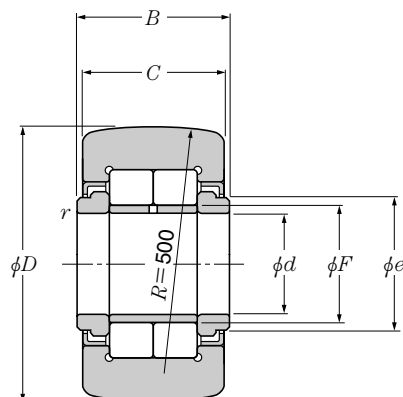
| Load ratings of truck |        |        |       | Limiting speeds |         | Bearing numbers       |                         | Mass      |
|-----------------------|--------|--------|-------|-----------------|---------|-----------------------|-------------------------|-----------|
|                       |        |        |       | r/min           |         |                       |                         | (approx.) |
|                       |        |        |       | grease          | oil     | Type                  | Type                    | kg        |
| N                     |        | kgf    |       |                 |         | NACV··X <sup>1)</sup> | NACV··XLL <sup>1)</sup> | Type      |
|                       |        |        |       |                 |         |                       |                         | NACV··X   |
| 4 600                 | 1 380  | 470    | 140   | 9 000           | ※11 000 | NACV12X               | NACV12XLL               | 0.027     |
| 5 350                 | 1 710  | 545    | 174   | 9 000           | ※11 000 | NACV14X               | NACV14XLL               | 0.036     |
| 7 400                 | 2 060  | 755    | 210   | 7 100           | 9 200   | NACV16X               | NACV16XLL               | 0.059     |
| 8 350                 | 2 430  | 850    | 248   | 7 100           | 9 200   | NACV18X               | NACV18XLL               | 0.073     |
| 11 400                | 2 840  | 1 160  | 290   | 5 400           | 7 000   | NACV20X               | NACV20XLL               | 0.109     |
| 12 500                | 3 250  | 1 280  | 330   | 5 400           | 7 000   | NACV22X               | NACV22XLL               | 0.132     |
| 16 300                | 3 600  | 1 660  | 365   | 4 800           | 6 200   | NACV24X               | NACV24XLL               | 0.177     |
| 17 600                | 4 050  | 1 800  | 410   | 4 800           | 6 200   | NACV26X               | NACV26XLL               | 0.218     |
| 21 600                | 4 400  | 2 200  | 450   | 4 100           | 5 300   | NACV28X               | NACV28XLL               | 0.281     |
| 23 200                | 4 850  | 2 360  | 495   | 4 100           | 5 300   | NACV30X               | NACV30XLL               | 0.327     |
| 31 000                | 5 300  | 3 150  | 540   | 3 700           | 4 800   | NACV32X               | NACV32XLL               | 0.454     |
| 35 000                | 6 200  | 3 550  | 635   | 3 700           | 4 800   | NACV36X               | NACV36XLL               | 0.585     |
| 44 500                | 7 200  | 4 550  | 735   | 3 200           | 4 100   | NACV40X               | NACV40XLL               | 0.902     |
| 49 000                | 8 250  | 5 000  | 840   | 3 200           | 4 100   | NACV44X               | NACV44XLL               | 1.05      |
| 64 000                | 9 150  | 6 500  | 935   | 2 700           | 3 500   | NACV48X               | NACV48XLL               | 1.39      |
| 69 000                | 10 000 | 7 050  | 1 020 | 2 700           | 3 500   | NACV52X               | NACV52XLL               | 1.66      |
| 86 000                | 11 100 | 8 800  | 1 130 | 2 200           | 2 800   | NACV56X               | NACV56XLL               | 2.19      |
| 112 500               | 13 200 | 11 500 | 1 350 | 2 200           | 2 800   | NACV64X               | NACV64XLL               | 3.22      |
| 165 500               | 17 900 | 16 900 | 1 830 | 1 500           | 1 900   | NACV80X               | NACV80XLL               | 6.08      |
| 239 500               | 22 100 | 24 400 | 2 250 | 1 200           | 1 500   | NACV96X               | NACV96XLL               | 10.0      |

Remarks: For the follower with seal, the maximum revolutions is allowable up to 10 000 r/min.

# Metric series

## Type NUTR2

## Type NUTR3



**D** 35~110mm

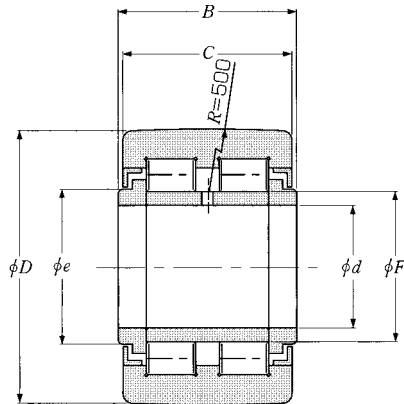
| Boundary dimensions<br>mm |                    |     |     |     |       |             | Basic load ratings    |                         |                         |                           | Load ratings of truck |        |              |              | Limiting<br>speeds<br>r/min<br>grease | Bearing <sup>2)</sup><br>numbers | Mass<br>kg<br>(approx.) |
|---------------------------|--------------------|-----|-----|-----|-------|-------------|-----------------------|-------------------------|-------------------------|---------------------------|-----------------------|--------|--------------|--------------|---------------------------------------|----------------------------------|-------------------------|
| $D$<br>$0$<br>$-0.05$     | $B$                | $C$ | $d$ | $e$ | $F_w$ | $r$ (min 1) | dynamic<br>N<br>$C_r$ | static<br>N<br>$C_{or}$ | dynamic<br>kgf<br>$C_r$ | static<br>kgf<br>$C_{or}$ | N                     | kgf    |              |              |                                       |                                  |                         |
| <b>35</b>                 | 19 $0$<br>$-0.210$ | 18  | 15  | 20  | 19    | 0.3         | 22 300                | 25 700                  | <b>2 280</b>            | <b>2 620</b>              | 3 200                 | 11 900 | <b>325</b>   | <b>1 220</b> | 5 500                                 | <b>NUTR202</b>                   | 0.100                   |
| <b>40</b>                 | 21 $0$<br>$-0.210$ | 20  | 17  | 22  | 21.5  | 0.3         | 24 100                | 29 100                  | <b>2 450</b>            | <b>2 970</b>              | 3 850                 | 14 500 | <b>390</b>   | <b>1 480</b> | 4 700                                 | <b>NUTR203</b>                   | 0.147                   |
| <b>42</b>                 | 19 $0$<br>$-0.210$ | 18  | 15  | 20  | 19    | 0.3         | 22 300                | 25 700                  | <b>2 280</b>            | <b>2 620</b>              | 4 100                 | 14 300 | <b>415</b>   | <b>1 460</b> | 5 500                                 | <b>NUTR302</b>                   | 0.160                   |
| <b>47</b>                 | 21 $0$<br>$-0.210$ | 20  | 17  | 22  | 21.5  | 0.3         | 24 100                | 29 100                  | <b>2 450</b>            | <b>2 970</b>              | 4 700                 | 17 000 | <b>480</b>   | <b>1 740</b> | 4 700                                 | <b>NUTR303</b>                   | 0.222                   |
|                           | 25 $0$<br>$-0.210$ | 24  | 20  | 27  | 25.5  | 0.3         | 38 500                | 48 000                  | <b>3 950</b>            | <b>4 900</b>              | 4 700                 | 21 000 | <b>480</b>   | <b>2 150</b> | 4 000                                 | <b>NUTR204</b>                   | 0.245                   |
| <b>52</b>                 | 25 $0$<br>$-0.210$ | 24  | 20  | 27  | 25.5  | 0.3         | 38 500                | 48 000                  | <b>3 950</b>            | <b>4 900</b>              | 5 550                 | 23 300 | <b>565</b>   | <b>2 370</b> | 4 000                                 | <b>NUTR304</b>                   | 0.321                   |
|                           | 25 $0$<br>$-0.210$ | 24  | 25  | 31  | 30    | 0.3         | 42 500                | 57 500                  | <b>4 350</b>            | <b>5 850</b>              | 5 550                 | 23 300 | <b>565</b>   | <b>2 370</b> | 3 300                                 | <b>NUTR205</b>                   | 0.281                   |
| <b>62</b>                 | 25 $0$<br>$-0.210$ | 24  | 25  | 31  | 30    | 0.3         | 42 500                | 57 500                  | <b>4 350</b>            | <b>5 850</b>              | 6 950                 | 27 800 | <b>710</b>   | <b>2 830</b> | 3 300                                 | <b>NUTR305</b>                   | 0.450                   |
|                           | 29 $0$<br>$-0.210$ | 28  | 30  | 38  | 35    | 0.3         | 56 500                | 72 500                  | <b>5 750</b>            | <b>7 400</b>              | 6 950                 | 33 000 | <b>710</b>   | <b>3 350</b> | 2 900                                 | <b>NUTR206</b>                   | 0.466                   |
| <b>72</b>                 | 29 $0$<br>$-0.210$ | 28  | 30  | 38  | 35    | 0.3         | 56 500                | 72 500                  | <b>5 750</b>            | <b>7 400</b>              | 8 050                 | 38 500 | <b>820</b>   | <b>3 900</b> | 2 900                                 | <b>NUTR306</b>                   | 0.697                   |
|                           | 29 $0$<br>$-0.210$ | 28  | 35  | 44  | 41.5  | 0.6         | 62 000                | 85 500                  | <b>6 350</b>            | <b>8 700</b>              | 8 050                 | 37 000 | <b>820</b>   | <b>3 750</b> | 2 400                                 | <b>NUTR207</b>                   | 0.630                   |
| <b>80</b>                 | 29 $0$<br>$-0.210$ | 28  | 35  | 44  | 41.5  | 0.6         | 62 000                | 85 500                  | <b>6 350</b>            | <b>8 700</b>              | 9 800                 | 41 000 | <b>1 000</b> | <b>4 150</b> | 2 400                                 | <b>NUTR307</b>                   | 0.840                   |
|                           | 32 $0$<br>$-0.250$ | 30  | 40  | 51  | 47.5  | 0.6         | 87 000                | 125 000                 | <b>8 850</b>            | <b>12 700</b>             | 9 800                 | 44 500 | <b>1 000</b> | <b>4 500</b> | 2 100                                 | <b>NUTR208</b>                   | 0.817                   |
| <b>85</b>                 | 32 $0$<br>$-0.250$ | 30  | 45  | 55  | 52.5  | 0.6         | 92 000                | 137 000                 | <b>9 350</b>            | <b>14 000</b>             | 10 400                | 47 000 | <b>1 060</b> | <b>4 800</b> | 1 900                                 | <b>NUTR209</b>                   | 0.883                   |
| <b>90</b>                 | 32 $0$<br>$-0.250$ | 30  | 40  | 51  | 47.5  | 0.6         | 87 000                | 125 000                 | <b>8 850</b>            | <b>12 700</b>             | 11 400                | 50 000 | <b>1 160</b> | <b>5 100</b> | 2 100                                 | <b>NUTR308</b>                   | 1.13                    |
|                           | 32 $0$<br>$-0.250$ | 30  | 50  | 60  | 57    | 0.6         | 96 500                | 150 000                 | <b>9 800</b>            | <b>15 300</b>             | 11 400                | 50 000 | <b>1 160</b> | <b>5 100</b> | 1 800                                 | <b>NUTR210</b>                   | 0.950                   |
| <b>100</b>                | 32 $0$<br>$-0.250$ | 30  | 45  | 55  | 52.5  | 0.6         | 92 000                | 137 000                 | <b>9 350</b>            | <b>14 000</b>             | 13 000                | 55 500 | <b>1 330</b> | <b>5 650</b> | 1 900                                 | <b>NUTR309</b>                   | 1.40                    |
| <b>110</b>                | 32 $0$<br>$-0.250$ | 30  | 50  | 60  | 57    | 0.6         | 96 500                | 150 000                 | <b>9 800</b>            | <b>15 300</b>             | 14 700                | 61 000 | <b>1 500</b> | <b>6 200</b> | 1 800                                 | <b>NUTR310</b>                   | 1.69                    |

Note 1) Allowable minimum chamfer dimension  $r$ .

2) For bearing with cylindrical outer surface, the nominal bearing is followed by "X". In this case, the bearing is manufactured with outer ring diameter tolerance conforming to JIS Class-0. Ex. **NUTR208X**

## Metric series

### Type NUTW2



**D** 35~90mm

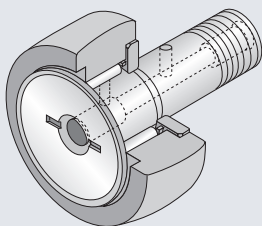
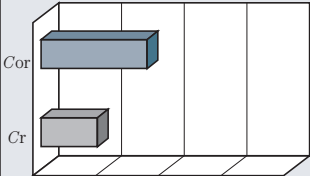
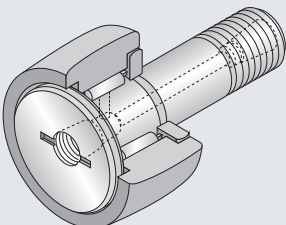
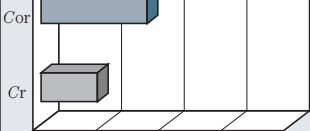
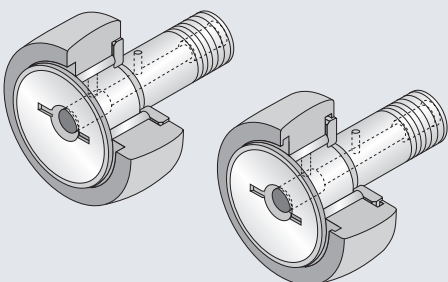
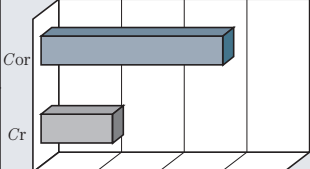
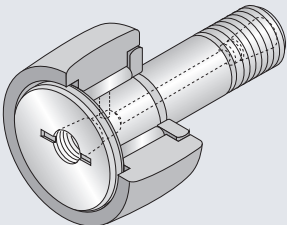
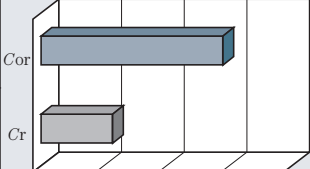
| Boundary dimensions<br>mm |                    |     |     |     |       |              |  | Basic load ratings |             |                |               | Load ratings of truck |        |       |       | Limiting<br>speeds<br>r/min<br>grease | Bearing <sup>2)</sup><br>numbers | Mass<br>kg<br>(approx.) |
|---------------------------|--------------------|-----|-----|-----|-------|--------------|--|--------------------|-------------|----------------|---------------|-----------------------|--------|-------|-------|---------------------------------------|----------------------------------|-------------------------|
| $D$<br>$0$<br>$-0.05$     | $B$                | $C$ | $d$ | $e$ | $F_w$ | $r_s$ min 1) |  | dynamic<br>N       | static<br>N | dynamic<br>kgf | static<br>kgf | N                     | kgf    |       |       |                                       |                                  |                         |
|                           |                    |     |     |     |       |              |  | $C_r$              | $C_{or}$    | $C_r$          | $C_{or}$      |                       |        |       |       |                                       |                                  |                         |
| 35                        | 22 $0$<br>$-0.210$ | 21  | 15  | 20  | 19    | 0.3          |  | 24 100             | 28 300      | 2 460          | 2 880         | 3 200                 | 14 200 | 325   | 1 450 | 5 500                                 | NUTW202                          | 0.115                   |
| 40                        | 24 $0$<br>$-0.210$ | 23  | 17  | 22  | 21.5  | 0.3          |  | 26 000             | 32 000      | 2 650          | 3 250         | 3 850                 | 17 100 | 390   | 1 740 | 4 700                                 | NUTW203                          | 0.167                   |
| 47                        | 29 $0$<br>$-0.210$ | 28  | 20  | 27  | 25.5  | 0.3          |  | 40 500             | 51 500      | 4 150          | 5 250         | 4 700                 | 25 100 | 480   | 2 560 | 4 000                                 | NUTW204                          | 0.280                   |
| 52                        | 29 $0$<br>$-0.210$ | 28  | 25  | 31  | 30    | 0.3          |  | 45 000             | 61 500      | 4 600          | 6 250         | 5 550                 | 27 700 | 565   | 2 830 | 3 300                                 | NUTW205                          | 0.322                   |
| 62                        | 35 $0$<br>$-0.210$ | 34  | 30  | 38  | 35    | 0.3          |  | 59 500             | 77 000      | 6 050          | 7 900         | 6 950                 | 41 000 | 710   | 4 200 | 2 900                                 | NUTW206                          | 0.549                   |
| 72                        | 35 $0$<br>$-0.210$ | 34  | 35  | 44  | 41.5  | 0.6          |  | 65 000             | 91 000      | 6 650          | 9 250         | 8 050                 | 46 000 | 820   | 4 700 | 2 400                                 | NUTW207                          | 0.747                   |
| 80                        | 38 $0$<br>$-0.250$ | 36  | 40  | 51  | 47.5  | 0.6          |  | 90 500             | 131 000     | 9 250          | 13 400        | 9 800                 | 54 500 | 1 000 | 5 550 | 2 100                                 | NUTW208                          | 0.953                   |
| 85                        | 38 $0$<br>$-0.250$ | 36  | 45  | 55  | 52.5  | 0.6          |  | 95 500             | 144 000     | 9 750          | 14 700        | 10 400                | 58 000 | 1 060 | 5 900 | 1 900                                 | NUTW209                          | 1.03                    |
| 90                        | 38 $0$<br>$-0.250$ | 36  | 50  | 60  | 57    | 0.6          |  | 100 000            | 158 000     | 10 200         | 16 100        | 11 400                | 61 500 | 1 160 | 6 250 | 1 800                                 | NUTW210                          | 1.11                    |

## Cam Followers (Stud Type Track Roller)

This is a track roller complete with stud instead of inner ring, which of the outer ring rolls 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 so threaded as to facilitate mounting thereof. And the outer ring is guided in

axial direction by the side plates which are press-fitted in the flange end of the stud and the stud itself.

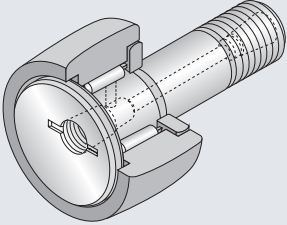
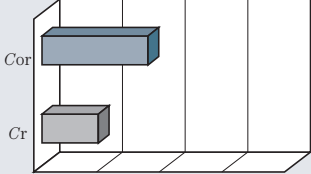
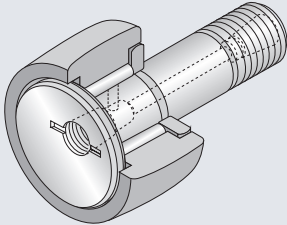
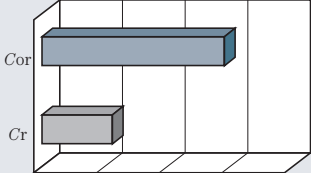
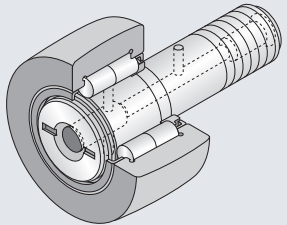
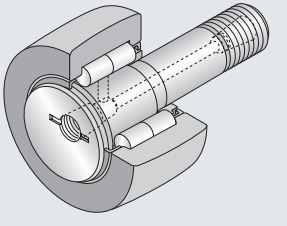
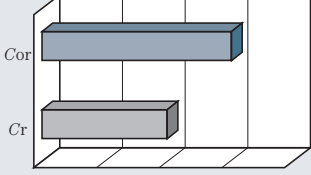
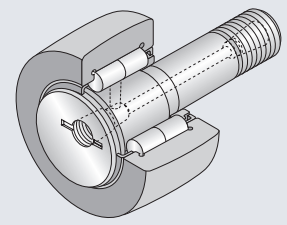
The outer ring has a thick wall and both of spherical outer profile and cylindrical outer surface (tail code: **X**) are available for it similarly to the outer ring of the roller follower.

| Follower type                                                                                                   | Applied shaft diameter (mm)                                                          | Load capacity                                                                                        | Composition of nominal bearing number                                                                                        |
|-----------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| <b>KR</b><br><b>CR</b><br>     | <b>KR :</b><br>$\phi 3 \sim \phi 30$<br><b>CR :</b><br>$\phi 4.826 \sim \phi 22.225$ |                   | <b>KR 12 T2 H / 3A</b><br>Tailed code<br>T2: Resin cage<br>H: With hexagon hole<br>3A: grease<br>Dimension code<br>Type code |
| <b>KRT</b><br>               | $\phi 6 \sim \phi 30$                                                                | <b>KR90</b><br>   | <b>KRT 32 X LL</b><br>Tail code<br>LL: Seal<br>Tailed code<br>X: Cylinder outer diameter<br>Dimension code<br>Type code      |
| <b>KRV</b><br><b>CRV</b><br> | <b>KRV :</b><br>$\phi 3 \sim \phi 30$<br><b>CRV :</b><br>$\phi 4.826 \sim \phi 63.5$ |                  | <b>CRV 30 X LL</b><br>Tail code<br>LL: Seal<br>Tailed code<br>X: Cylinder outer diameter<br>Dimension code<br>Type code      |
| <b>KRVT</b><br>              | $\phi 6 \sim \phi 30$                                                                | <b>KRV90</b><br> | <b>KRVT 52 X LL</b><br>Tail code<br>LL: Seal<br>Tailed code<br>X: Cylinder outer diameter<br>Dimension code<br>Type code     |

※Each listed load capacity is subject to the reference bearing diameter of  $\phi 30$ .



| Follower components                                                                                                                                                                                                          | Features                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Outer ring outer diameter : $\phi 12$<br>With metric series cage<br>Without seal<br>Outer profile : spherical<br>Stud head : with hexagon hole<br>Cage : resin cage<br>Grease : already filled                               | <ul style="list-style-type: none"> <li>• Standard cage is of steel plate punched type.</li> <li>• Polyamide resin cage (Tail code: T2) can be used, too.<br/>Allowable temperature: 120°C<br/>Continuous operating temperature: 100°C or less</li> <li>• Suited to high speed.</li> <li>• Due to much filled grease, these types can be used for a long time without additional greasing though actual operating conditions.</li> <li>• The standard follower of Type KRT has no hexagon hole (tail code: H), but with a threaded plug with hexagon socket as standard.</li> <li>• The follower with neither seal nor grease code as tail code is of grease non-filled type.</li> </ul> |
| Outer ring outer diameter : $\phi 32$<br>With metric series cage<br>Stud head : with recessed slot for screwdriver use and tapped hole<br>Outer surface profile : cylindrical<br>Seal : with<br>Grease : already filled.     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Outer ring outer diameter : $\phi 47.825$<br>Inch series full-complement roller type<br>Stud head : with recessed slot for screwdriver use<br>Outer surface profile : cylindrical<br>Seal : with<br>Grease : already filled. | <ul style="list-style-type: none"> <li>• Suited to high load.</li> <li>• Lower allowable running speed than the type with cage.</li> <li>• Grease replenishing interval must be shortened due to the small spacing volume.</li> <li>• The standard follower of Type KRV has no hexagon hole (tail code H), but with a threaded plug with hexagon socket as standard.</li> </ul>                                                                                                                                                                                                                                                                                                         |
| Outer ring outer diameter : $\phi 32$<br>With metric series cage<br>Stud head : With recessed slot for screwdriver use and tapped hole<br>Outer surface profile : cylindrical<br>Seal : with<br>Grease : already filled.     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

| Follower type                                                                                       | Applied shaft diameter (mm) | Load capacity                                                                                             | Composition of nominal bearing number                                                                                                                                                                    |
|-----------------------------------------------------------------------------------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>KRU</b><br>     | $\phi 6 \sim \phi 30$       |  <p><b>KRU90</b></p>    | <p><b>KRU 32 LL</b></p> <ul style="list-style-type: none"> <li>LL: seal (Tail code)</li> <li>32 (Dimension code)</li> <li>KRU (Type code)</li> </ul>                                                     |
| <b>KRVU</b><br>    | $\phi 6 \sim \phi 30$       |  <p><b>KRVU90</b></p>   | <p><b>KRVU 62 X LL</b></p> <ul style="list-style-type: none"> <li>LL: seal (Tail code)</li> <li>X: Cylinder outer diameter (Tail code)</li> <li>62 (Dimension code)</li> <li>KRVU (Type code)</li> </ul> |
| <b>NUKR</b><br>  | $\phi 12 \sim \phi 64$      |                                                                                                           | <p><b>NUKR 80 H</b></p> <ul style="list-style-type: none"> <li>H: with hexagon socket (Tail code)</li> <li>80 (Dimension code)</li> <li>NUKR (Type code)</li> </ul>                                      |
| <b>NUKRT</b><br> | $\phi 12 \sim \phi 64$      |  <p><b>NUKR90</b></p> | <p><b>NUKRT 90</b></p> <ul style="list-style-type: none"> <li>90 (Dimension code)</li> <li>NUKRT (Type code)</li> </ul>                                                                                  |
| <b>NUKRU</b><br> | $\phi 12 \sim \phi 64$      |                                                                                                           | <p><b>NUKRU 140 X</b></p> <ul style="list-style-type: none"> <li>X: Cylinder outer diameter (Tail code)</li> <li>140 (Dimension code)</li> <li>NUKRU (Type code)</li> </ul>                              |

※ 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><br/>Metric series stud with cage, eccentric type<br/>Stud head : with recessed slot for screwdriver use and tapped hole<br/>Outer profile: spherical<br/>Seal : with<br/>Grease : already filled</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>● The standard follower has no hexagon hole (tail code H), but with a threaded plug with hexagon socket as standard.</li> <li>● Type KRU --without seal. In addition, the same follower with no grease code is of grease non-filled type.</li> </ul>                                                                                                                                                                                      |
| <p>Outer ring outer diameter: <math>\phi 62</math><br/>Metric series stud with cage, eccentric type<br/>Stud head : Metric series full-complement roller type stud, eccentric type<br/>Seal : with<br/>Outer profile: cylindrical<br/>Grease : already filled</p>                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <p>Outer ring outer diameter: <math>\phi 80</math><br/>Metric series double-row cylindrical roller type<br/>Shielded full-complement roller type<br/>Stud head : with hexagon socket<br/>Seal : with<br/>Outer profile: spherical<br/>Grease : already filled</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> <li>● The standard followers of Type NUKRT and NUKRU have no hexagon hole (tail code H), but with a threaded plug with hexagon socket as standard.</li> </ul> |
| <p>Outer ring outer diameter: <math>\phi 90</math><br/>Metric series double-row cylindrical roller type<br/>Shielded full-complement roller type<br/>Stud head : with recessed slot for screwdriver use and tapped hole<br/>Outer profile: spherical<br/>Grease : already filled</p>                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <p>Outer ring outer diameter: <math>\phi 140</math><br/>Metric series double-row cylindrical roller type<br/>Shielded full-complement roller type stud, eccentric type<br/>Stud head : with recessed slot for screwdriver use and tapped hole<br/>Outer profile: cylindrical<br/>Grease : already filled</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                                      |

**Table 2 Radial internal clearance**

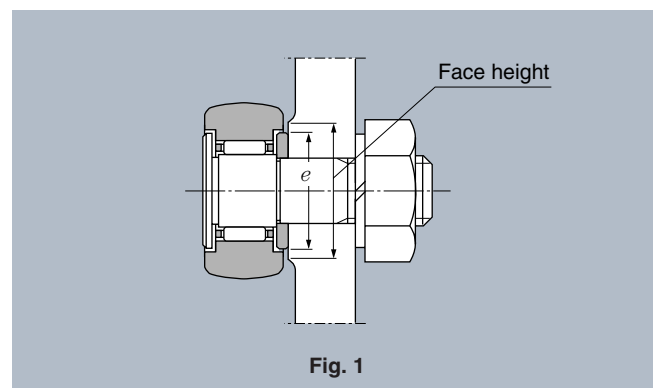
Unit :  $\mu\text{m}$

| Nominal roller inscribed circle diameter $F_w$ (mm) |       | Clearance |     |               |     |     |     |     |     |
|-----------------------------------------------------|-------|-----------|-----|---------------|-----|-----|-----|-----|-----|
|                                                     |       | C2        |     | CN (ordinary) |     | C3  |     | C4  |     |
| over                                                | incl. | min       | max | min           | max | min | max | min | max |
| 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 |

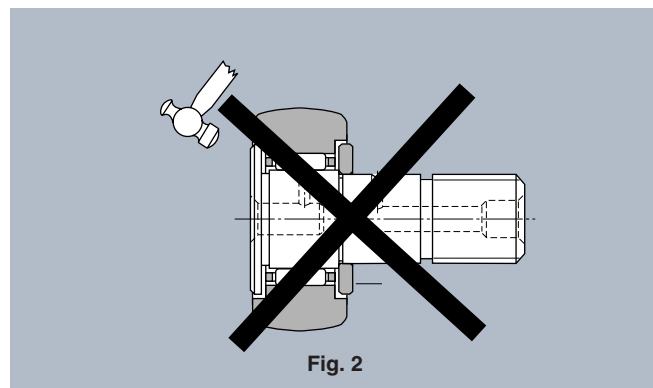
**Note)** When shock load acts on, make the stud - hole clearance as less as possible in assembling.

## Fitting relations

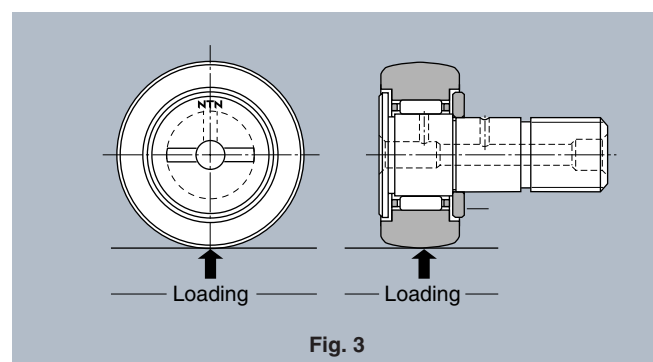
- (1) Make the face height at the cam follower mount greater than " $e$ " dimension given in applicable Dimension Table. (**Fig.1**)  
Furthermore, chamfer the stud mounting hole at  $R$  as small as possible (around  $0.5 \times 45^\circ$ ) and bring the side faces of side face in precise contact.



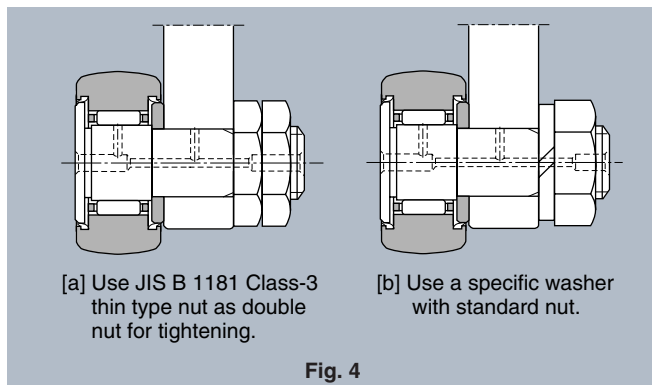
- (2) Don't hammer directly the cam follower rib. Doing so would cause breakdown and rotation failure of the rib.



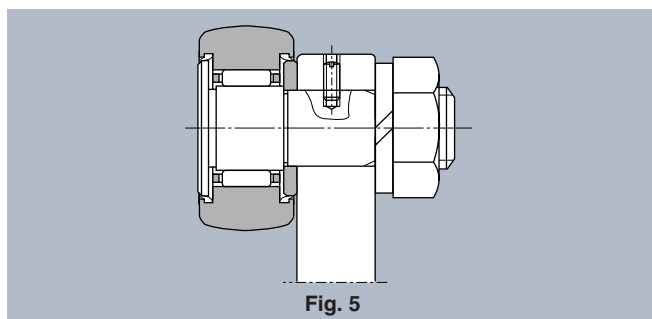
- (3) The oil hole position on the stud raceway surface is shown with NTN mark stamped on the stud rib surface. Mount the stud so the oil hole locates within the non-load area (non-load side). (**Fig. 3**) If the oil hole locates within the load area, it would cause shorter life of the follower.



- (4) Particularly where loose of the mounting screw is forecast due to wide amplitude vibration during running, the mounting methods as illustrated in **Fig. 4** are available.



- (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.



- (7) For mounting and adjusting the eccentric stud type cam follower, follow the sequence given hereunder.
1. Insert the stud in the mounting hole so that the **NTN** mark (showing oil hole position) locates in relative to load acting direction as illustrated in **Fig. 3**.
  2. Turn the stud using the recessed slot for screwdriver on the stud head or the accessory threaded plug with hexagon socket, to adjust a clearance from the mating contact surface.
  3. After adjustment, tighten the stud nut with specific tightening torque described in applicable Dimensions Table.

**NTN cam follower is generally stud-mounted so that non-uniform load (bias load) could act on the bearing, inversely affected by fitting loose arising from continuous running.**

**So, good care must be exercised of fitting loose for stable running of an equipment.**

## Lubrication and how to feed and replenish grease into the follower

### Lubrication

The cam follower type with synthetic rubber seal (with tail code LL) and the full-complement roller type are pre-filled up with lithium soap base grease so they can be used in the operating temperature range of -25 to +100°C.

The type with cage and with no seal is not filled up with grease. If a grease pre-filled type is needed, feel free to contact NTN.

Further, NTN Bearings with Solid Dreeze using solid lubricant of less leakage is also available on request. Feel free to contact NTN for the detailed information.

**The outer ring outer surface of bearing and the track surface must both be lubricated. Failure to lubricate could result earlier in damage of bearing.**

### How to feed and replenish grease

Feed and replenish grease through a grease nipple provided on the flange end face or threaded-side end face 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.

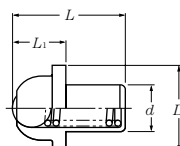
Special grease nipple and that specified in JIS Standard as applicable are available for use. The dimensions thereof and the applicable bearing types are as specified in **Tables 3** and **4** respectively.

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</i> <sub>1</sub> |
| 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>ℓ</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       |

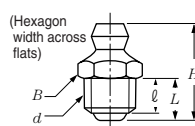


Table 4 Grease nipple applied bearing types and grease nipple dimension codes

| Nominal nipple number | Nipple applied bearing types |             |       |       |                            |         |           |        |           |        |
|-----------------------|------------------------------|-------------|-------|-------|----------------------------|---------|-----------|--------|-----------|--------|
|                       | KR, KRV                      | KR·H, KRV·H | CRV   | CRV·H | NUKR                       | NUKR·H  | KRT, KRVT | NUKRT  | KRU, KRVU | NUKRU  |
| NIP-B3                | —                            | —           | 8.8-1 | —     | —                          | —       | —         | —      | —         | —      |
| NIP-B4                | 16~26                        | 22~26       | 10~18 | 12~18 | —                          | —       | —         | —      | —         | —      |
| NIP-B6                | 30~40                        | 30~40       | 20~44 | 20~44 | 30~40                      | 30~40   | —         | —      | —         | —      |
| NIP-B8                | 47~90                        | 47~90       | 48~96 | 48~96 | 47~90                      | 47~90   | —         | —      | —         | —      |
| NIP-X30               | —                            | —           | —     | —     | —                          | —       | 16~26     | —      | 16~26     | —      |
| JIS A-M6F             | —                            | —           | —     | —     | —                          | —       | 30~32     | 30     | 30~35     | 30~35  |
| JIS A-PT1/8           | —                            | —           | —     | —     | 100~180<br>(Threaded side) | 100~180 | 35~90     | 35~180 | 40~90     | 40~180 |

Special-purposed plug

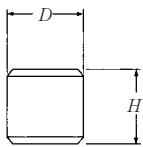


Table 5-1 Plug dimension

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

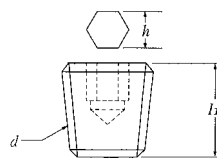


Table 5-2 Plug dimension

unit : mm

| Nominal number | d       | H | Width across flats h |
|----------------|---------|---|----------------------|
| M4X0.7X4 ℓ     | M4X0.7  | 4 | 2                    |
| M6X0.75X6 ℓ    | M6X0.75 | 6 | 3                    |
| PT1/8X7 ℓ      | 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 | CRV   | CRV·H | NUKR   | NUKR·H  | KRT, KRVT | NUKRT  | KRU, KRVU | NUKRU  |
| SEN3        | —                          | —           | 8.8-1 | —     | —      | —       | —         | —      | —         | —      |
| SEN4        | 16~26                      | 22~26       | 10~18 | 12~18 | —      | —       | —         | —      | —         | —      |
| SEN6        | 30~40                      | 30~40       | 20~44 | 20~44 | 30~40  | 30~40   | —         | —      | —         | —      |
| SEN8        | 47~90                      | 47~90       | 48~96 | 48~96 | 47~180 | 47~90   | —         | —      | —         | —      |
| M4X0.7X4 ℓ  | —                          | —           | —     | —     | —      | —       | 16~26     | —      | 16~26     | —      |
| M6X0.75X6 ℓ | —                          | —           | —     | —     | —      | —       | 30~32     | 30     | 30~35     | 30~35  |
| PT1/8X7 ℓ   | —                          | —           | —     | —     | —      | 100~180 | 35~90     | 35~180 | 40~90     | 40~180 |

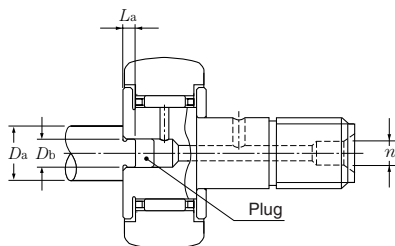


Table 7 Mandrels used for plug press-fitting

unit : mm

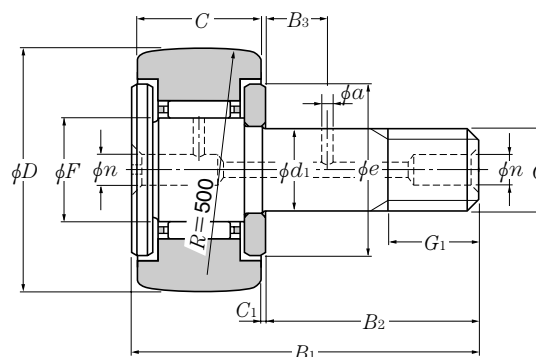
| Grease feed hole dia.<br>n | Mandrel dimension |                                 |                                 |
|----------------------------|-------------------|---------------------------------|---------------------------------|
|                            | Da                | Db <sup>0</sup> <sub>-0.1</sub> | La <sup>0</sup> <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**

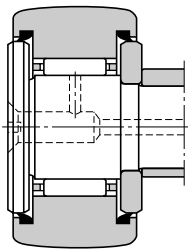
Maximum radial load which is statically allowable on the track roller to track contact surface is referred to as "track load capacity", and the track load capacity subject to track surface hardness HRC40 is as described in applicable Dimensions Table.

Where the track surface hardness is other than HRD40, adjust the track load capacity using the adjustment factor shown in **Table 11.1**.

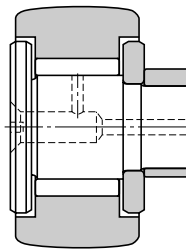
## Type KRV・・LL



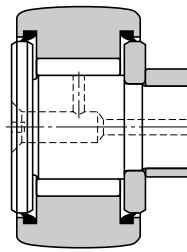




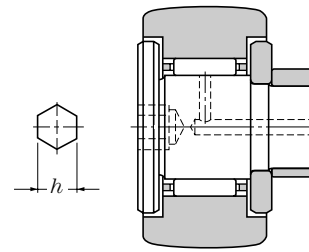
**Type KR·LL**  
(Sealed type with cage)



**Type KRV**  
(Full complement type)



**Type KRV·LL**  
(Full complement type with seal)



**Type KR·H**  
(With hexagonal wrench socket)

| Basic load ratings |                 |                |                 | Load ratings of truck   |                           |                         |                           | Limiting speeds |         | Maximum tightening torque |       | Bearing numbers                   |                                         | Mass (approx.) |          |
|--------------------|-----------------|----------------|-----------------|-------------------------|---------------------------|-------------------------|---------------------------|-----------------|---------|---------------------------|-------|-----------------------------------|-----------------------------------------|----------------|----------|
| dynamic static     |                 | dynamic static |                 | N                       |                           | kgf                     |                           | r/min           |         | N·m                       |       | Type NR <sup>1)</sup><br>Type KRV | Type NR·LL <sup>1)</sup><br>Type KRV·LL | Type KR        | Type KRV |
| C <sub>r</sub>     | C <sub>or</sub> | C <sub>r</sub> | C <sub>or</sub> | Spherical<br>outer ring | Cylindrical<br>outer ring | Spherical<br>outer ring | Cylindrical<br>outer ring | grease          | oil     |                           | kgf·m |                                   |                                         |                |          |
| 1 640              | 1 270           | 168            | 130             | 560                     | 1 360                     | 57                      | 139                       | ※27 000         | ※40 000 | 0.5                       | 0.05  | KR10T2H/3A                        | KR10T2LLH                               | 0.005          | —        |
| 2 500              | 2 610           | 255            | 267             | 560                     | 1 360                     | 57                      | 139                       | ※25 000         | ※32 000 | 0.5                       | 0.05  | KRV10H                            | KRV10LLH                                | —              | 0.005    |
| 2 170              | 1 690           | 221            | 172             | 725                     | 1 790                     | 74                      | 183                       | ※25 000         | ※36 000 | 1                         | 0.1   | KR12T2H/3A                        | KR12T2LLH                               | 0.008          | —        |
| 3 500              | 3 800           | 360            | 385             | 725                     | 1 790                     | 74                      | 183                       | ※20 000         | ※27 000 | 1                         | 0.1   | KRV12H                            | KRV12LLH                                | —              | 0.008    |
| 2 650              | 2 260           | 270            | 231             | 805                     | 2 220                     | 82                      | 226                       | ※23 000         | ※33 000 | 2                         | 0.2   | KR13T2H/3A                        | KR13T2LLH                               | 0.010          | —        |
| 4 500              | 5 350           | 455            | 545             | 805                     | 2 220                     | 82                      | 226                       | ※17 000         | ※22 000 | 2                         | 0.2   | KRV13H                            | KRV13LLH                                | —              | 0.011    |
| 4 050              | 4 200           | 415            | 430             | 1 080                   | 3 400                     | 110                     | 350                       | ※19 000         | ※25 000 | 3                         | 0.3   | KR16                              | KR16LL                                  | 0.019          | —        |
| 6 500              | 9 350           | 665            | 955             | 1 080                   | 3 400                     | 110                     | 350                       | ※13 000         | ※16 000 | 3                         | 0.3   | KRV16                             | KRV16LL                                 | —              | 0.020    |
| 4 750              | 5 400           | 480            | 555             | 1 380                   | 4 050                     | 141                     | 415                       | ※15 000         | ※20 000 | 8                         | 0.8   | KR19                              | KR19LL                                  | 0.031          | —        |
| 7 450              | 11 700          | 760            | 1 190           | 1 380                   | 4 050                     | 141                     | 415                       | 10 000          | ※13 000 | 8                         | 0.8   | KRV19                             | KRV19LL                                 | —              | 0.032    |
| 5 300              | 6 650           | 540            | 680             | 1 690                   | 5 150                     | 172                     | 525                       | ※12 000         | ※16 000 | 14                        | 1.4   | KR22                              | KR22LL                                  | 0.046          | —        |
| 8 200              | 14 000          | 840            | 1 420           | 1 690                   | 5 150                     | 172                     | 525                       | 8 500           | ※11 000 | 14                        | 1.4   | KRV22                             | KRV22LL                                 | —              | 0.047    |
| 5 300              | 6 650           | 540            | 680             | 2 120                   | 6 100                     | 216                     | 620                       | ※12 000         | ※16 000 | 14                        | 1.4   | KR26                              | KR26LL                                  | 0.059          | —        |
| 8 200              | 14 000          | 840            | 1 420           | 2 120                   | 6 100                     | 216                     | 620                       | 8 500           | ※11 000 | 14                        | 1.4   | KRV26                             | KRV26LL                                 | —              | 0.061    |
| 7 850              | 9 650           | 800            | 985             | 2 620                   | 7 700                     | 267                     | 785                       | 10 000          | ※13 000 | 20                        | 2     | KR30                              | KR30LL                                  | 0.087          | —        |
| 12 000             | 20 300          | 1 230          | 2 070           | 2 620                   | 7 700                     | 267                     | 785                       | 6 500           | 8 500   | 20                        | 2     | KRV30                             | KRV30LL                                 | —              | 0.089    |
| 7 850              | 9 650           | 800            | 985             | 2 860                   | 8 200                     | 291                     | 835                       | 10 000          | ※13 000 | 20                        | 2     | KR32                              | KR32LL                                  | 0.097          | —        |
| 12 000             | 20 300          | 1 230          | 2 070           | 2 860                   | 8 200                     | 291                     | 835                       | 6 500           | 8 500   | 20                        | 2     | KRV32                             | KRV32LL                                 | —              | 0.100    |
| 12 200             | 17 900          | 1 240          | 1 830           | 3 200                   | 11 900                    | 325                     | 1 220                     | 8 000           | ※11 000 | 52                        | 5.3   | KR35                              | KR35LL                                  | 0.169          | —        |
| 17 600             | 34 000          | 1 790          | 3 500           | 3 200                   | 11 900                    | 325                     | 1 220                     | 5 500           | 7 000   | 52                        | 5.3   | KRV35                             | KRV35LL                                 | —              | 0.172    |
| 14 000             | 22 800          | 1 430          | 2 330           | 3 850                   | 14 500                    | 390                     | 1 480                     | 7 000           | 9 000   | 76                        | 7.8   | KR40                              | KR40LL                                  | 0.248          | —        |
| 19 400             | 42 000          | 1 980          | 4 250           | 3 850                   | 14 500                    | 390                     | 1 480                     | 4 500           | 6 000   | 76                        | 7.8   | KRV40                             | KRV40LL                                 | —              | 0.252    |
| 20 700             | 33 500          | 2 110          | 3 450           | 4 700                   | 21 000                    | 480                     | 2 150                     | 6 000           | 8 000   | 98                        | 10    | KR47                              | KR47LL                                  | 0.386          | —        |
| 28 800             | 61 000          | 2 940          | 6 250           | 4 700                   | 21 000                    | 480                     | 2 150                     | 4 000           | 5 000   | 98                        | 10    | KRV47                             | KRV47LL                                 | —              | 0.390    |
| 20 700             | 33 500          | 2 110          | 3 450           | 5 550                   | 23 300                    | 565                     | 2 370                     | 6 000           | 8 000   | 98                        | 10    | KR52                              | KR52LL                                  | 0.461          | —        |
| 28 800             | 61 000          | 2 940          | 6 250           | 5 550                   | 23 300                    | 565                     | 2 370                     | 4 000           | 5 000   | 98                        | 10    | KRV52                             | KRV52LL                                 | —              | 0.465    |

Note 3) Cam follower with hexagon hole is standard.

Remarks: For the cam follower with ※marked seal, the allowable running speed is approximately 10 000 r/min.

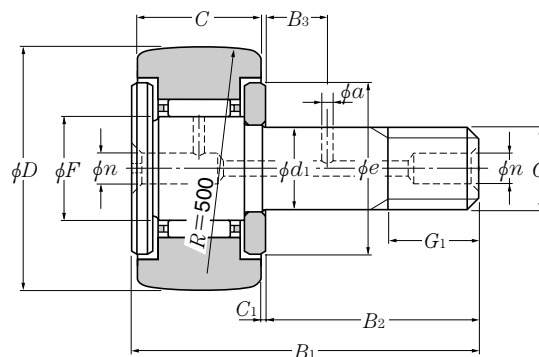
## Metric series

Type KR

Type KR··LL

Type KRV

Type KRV··LL

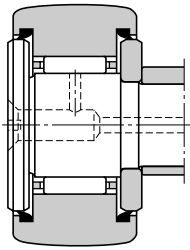
Type KR  
(With cage)

D 62~90mm

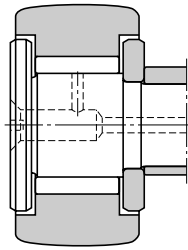
Boundary dimensions

| $D$<br>$\begin{smallmatrix} 0 \\ -0.050 \end{smallmatrix}$ | $C$ | $d_1$                                                  | $F$ | $B_1$ | $B_2$ | $G$<br>mm | $G_1$ | $C_1$ | $n$ | $B_3$ | $a$ | $e$ | $h$ |
|------------------------------------------------------------|-----|--------------------------------------------------------|-----|-------|-------|-----------|-------|-------|-----|-------|-----|-----|-----|
| 62                                                         | 29  | $24 \begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$ | 30  | 80    | 49.5  | M24×1.5   | 25    | 0.8   | 8   | 11    | 4   | 44  | 8   |
|                                                            | 29  | $24 \begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$ | 30  | 80    | 49.5  | M24×1.5   | 25    | 0.8   | 8   | 11    | 4   | 44  | 8   |
| 72                                                         | 29  | $24 \begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$ | 30  | 80    | 49.5  | M24×1.5   | 25    | 0.8   | 8   | 11    | 4   | 44  | 8   |
|                                                            | 29  | $24 \begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$ | 30  | 80    | 49.5  | M24×1.5   | 25    | 0.8   | 8   | 11    | 4   | 44  | 8   |
| 80                                                         | 35  | $30 \begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$ | 38  | 100   | 63    | M30×1.5   | 32    | 1     | 8   | 15    | 4   | 53  | 8   |
|                                                            | 35  | $30 \begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$ | 38  | 100   | 63    | M30×1.5   | 32    | 1     | 8   | 15    | 4   | 53  | 8   |
| 85                                                         | 35  | $30 \begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$ | 38  | 100   | 63    | M30×1.5   | 32    | 1     | 8   | 15    | 4   | 53  | 8   |
|                                                            | 35  | $30 \begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$ | 38  | 100   | 63    | M30×1.5   | 32    | 1     | 8   | 15    | 4   | 53  | 8   |
| 90                                                         | 35  | $30 \begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$ | 38  | 100   | 63    | M30×1.5   | 32    | 1     | 8   | 15    | 4   | 53  | 8   |
|                                                            | 35  | $30 \begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$ | 38  | 100   | 63    | M30×1.5   | 32    | 1     | 8   | 15    | 4   | 53  | 8   |

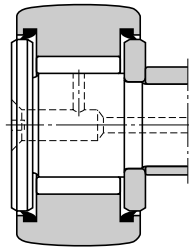
Note 1) For bearing with cylindrical outer surface, the nominal number is followed by "X" code. In this case, the cylindrical bearing is manufactured with the tolerance for outer ring outer diameter  $D$  which conforms to JIS Class-0. Ex. KR62XLL



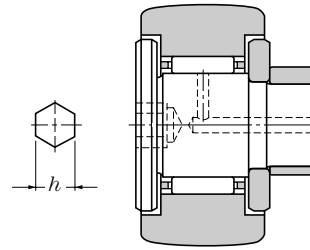
**Type KR··LL**  
(Sealed type with cage)



**Type KRV**  
(Full complement type)



**Type KRV··LL**  
(Full complement type with seal)



**Type KR··H**  
(With hexagonal wrench socket)

| Basic load ratings |          |                |          | Load ratings of truck   |                           |                         |                           | Limiting speeds |       | Maximum tightening torque |       | Bearing numbers                   |                                           | Mass (approx.) |          |
|--------------------|----------|----------------|----------|-------------------------|---------------------------|-------------------------|---------------------------|-----------------|-------|---------------------------|-------|-----------------------------------|-------------------------------------------|----------------|----------|
| dynamic static     |          | dynamic static |          | N                       |                           | kgf                     |                           | r /min          |       | N·m                       |       | Type NR <sup>1)</sup><br>Type KRV | Type NR··LL <sup>1)</sup><br>Type KRV··LL | Type KR        | Type KRV |
| $C_r$              | $C_{or}$ | $C_r$          | $C_{or}$ | Spherical<br>outer ring | Cylindrical<br>outer ring | Spherical<br>outer ring | Cylindrical<br>outer ring | grease          | oil   |                           | kgf·m |                                   |                                           |                |          |
| 28 900             | 55 000   | 2 950          | 5 600    | 6 950                   | 34 500                    | 710                     | 3 500                     | 5 000           | 6 500 | 178                       | 18    | KR62                              | KR62LL                                    | 0.790          | —        |
| 39 500             | 98 500   | 4 000          | 10 000   | 6 950                   | 34 500                    | 710                     | 3 500                     | 3 300           | 4 500 | 178                       | 18    | KRV62                             | KRV62LL                                   | —              | 0.800    |
| 28 900             | 55 000   | 2 950          | 5 600    | 8 050                   | 38 500                    | 820                     | 3 900                     | 5 000           | 6 500 | 178                       | 18    | KR72                              | KR72LL                                    | 1.04           | —        |
| 39 500             | 98 500   | 4 000          | 10 000   | 8 050                   | 38 500                    | 820                     | 3 900                     | 3 300           | 4 500 | 178                       | 18    | KRV72                             | KRV72LL                                   | —              | 1.05     |
| 45 000             | 88 500   | 4 600          | 9 050    | 9 800                   | 53 000                    | 1 000                   | 5 400                     | 40 00           | 5 500 | 360                       | 37    | KR80                              | KR80LL                                    | 1.55           | —        |
| 58 000             | 147 000  | 5 900          | 15 000   | 9 800                   | 53 000                    | 1 000                   | 5 400                     | 2 600           | 3 500 | 360                       | 37    | KRV80                             | KRV80LL                                   | —              | 1.56     |
| 45 000             | 88 500   | 4 600          | 9 050    | 10 400                  | 56 000                    | 1 060                   | 5 750                     | 4 000           | 5 500 | 360                       | 37    | KR85                              | KR85LL                                    | 1.74           | —        |
| 45 000             | 88 500   | 4 600          | 9 050    | 11 400                  | 59 000                    | 1 160                   | 6 100                     | 4 000           | 5 500 | 360                       | 37    | KR90                              | KR90LL                                    | 1.95           | —        |
| 58 000             | 147 000  | 5 900          | 15 000   | 11 400                  | 59 000                    | 1 160                   | 6 100                     | 2 600           | 3 500 | 360                       | 37    | KRV90                             | KRV90LL                                   | —              | 1.97     |

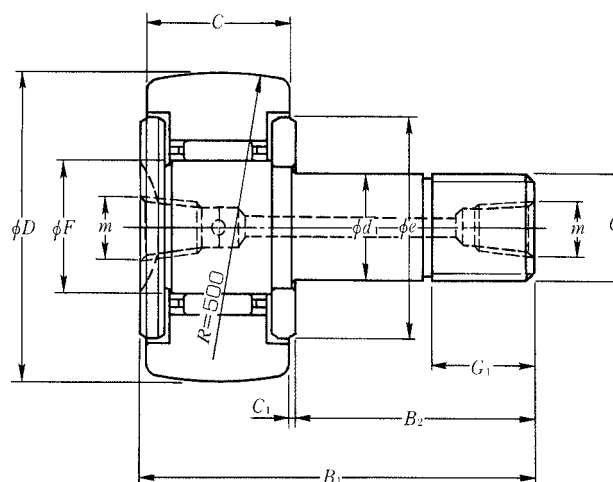
## Metric series

Type KRT

Type KRT··X

Type KRT··LL

Type KRT··XLL

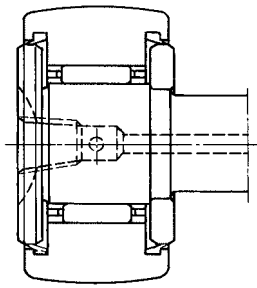
Type KRT  
(With cage)

D 16~90mm

| Boundary dimensions |    |                                   |    |                |                |          |                |                |    |                                | Basic load ratings |                 |                |                 |
|---------------------|----|-----------------------------------|----|----------------|----------------|----------|----------------|----------------|----|--------------------------------|--------------------|-----------------|----------------|-----------------|
| mm                  |    |                                   |    |                |                |          |                |                |    |                                | dynamic            | static          | dynamic        | static          |
| D <sup>1)</sup>     | C  | d <sub>1</sub>                    | F  | B <sub>1</sub> | B <sub>2</sub> | G        | G <sub>1</sub> | C <sub>1</sub> | e  | m                              | C <sub>r</sub>     | C <sub>or</sub> | C <sub>r</sub> | C <sub>or</sub> |
| 16                  | 11 | 6 <sup>0</sup> <sub>-0.012</sub>  | 8  | 28             | 16             | M 6×1    | 8              | 0.6            | 12 | M4×0.7 <sup>2)</sup>           | 4 050              | 4 200           | 415            | 430             |
| 19                  | 11 | 8 <sup>0</sup> <sub>-0.015</sub>  | 10 | 32             | 20             | M 8×1.25 | 10             | 0.6            | 14 | M4×0.7 <sup>2)</sup>           | 4 750              | 5 400           | 480            | 555             |
| 22                  | 12 | 10 <sup>0</sup> <sub>-0.015</sub> | 12 | 36             | 23             | M10×1.25 | 12             | 0.6            | 17 | M4×0.7                         | 5 300              | 6 650           | 540            | 680             |
| 26                  | 12 | 10 <sup>0</sup> <sub>-0.015</sub> | 12 | 36             | 23             | M10×1.25 | 12             | 0.6            | 17 | M4×0.7                         | 5 300              | 6 650           | 540            | 680             |
| 30                  | 14 | 12 <sup>0</sup> <sub>-0.018</sub> | 15 | 40             | 25             | M12×1.5  | 13             | 0.6            | 23 | M6×0.75                        | 7 850              | 9 650           | 800            | 985             |
| 32                  | 14 | 12 <sup>0</sup> <sub>-0.018</sub> | 15 | 40             | 25             | M12×1.5  | 13             | 0.6            | 23 | M6×0.75                        | 7 850              | 9 650           | 800            | 985             |
| 35                  | 18 | 16 <sup>0</sup> <sub>-0.018</sub> | 18 | 52             | 32.5           | M16×1.5  | 17             | 0.8            | 27 | PT <sup>1</sup> / <sub>8</sub> | 12 200             | 17 900          | 1 240          | 1 830           |
| 40                  | 20 | 18 <sup>0</sup> <sub>-0.018</sub> | 22 | 58             | 36.5           | M18×1.5  | 19             | 0.8            | 32 | PT <sup>1</sup> / <sub>8</sub> | 14 000             | 22 800          | 1 430          | 2 330           |
| 47                  | 24 | 20 <sup>0</sup> <sub>-0.021</sub> | 25 | 66             | 40.5           | M20×1.5  | 21             | 0.8            | 37 | PT <sup>1</sup> / <sub>8</sub> | 20 700             | 33 500          | 2 110          | 3 450           |
| 52                  | 24 | 20 <sup>0</sup> <sub>-0.021</sub> | 25 | 66             | 40.5           | M20×1.5  | 21             | 0.8            | 37 | PT <sup>1</sup> / <sub>8</sub> | 20 700             | 33 500          | 2 110          | 3 450           |
| 62                  | 29 | 24 <sup>0</sup> <sub>-0.021</sub> | 30 | 80             | 49.5           | M24×1.5  | 25             | 0.8            | 44 | PT <sup>1</sup> / <sub>8</sub> | 28 900             | 55 000          | 2 950          | 5 600           |
| 72                  | 29 | 24 <sup>0</sup> <sub>-0.021</sub> | 30 | 80             | 49.5           | M24×1.5  | 25             | 0.8            | 44 | PT <sup>1</sup> / <sub>8</sub> | 28 900             | 55 000          | 2 950          | 5 600           |
| 80                  | 35 | 30 <sup>0</sup> <sub>-0.021</sub> | 38 | 100            | 63             | M30×1.5  | 32             | 1              | 53 | PT <sup>1</sup> / <sub>8</sub> | 45 000             | 88 500          | 4 600          | 9 050           |
| 85                  | 35 | 30 <sup>0</sup> <sub>-0.021</sub> | 38 | 100            | 63             | M30×1.5  | 32             | 1              | 53 | PT <sup>1</sup> / <sub>8</sub> | 45 000             | 88 500          | 4 600          | 9 050           |
| 90                  | 35 | 30 <sup>0</sup> <sub>-0.021</sub> | 38 | 100            | 63             | M30×1.5  | 32             | 1              | 53 | PT <sup>1</sup> / <sub>8</sub> | 45 000             | 88 500          | 4 600          | 9 050           |

Note 1) The dimensional tolerances for the outer ring outer diameter *D* of Type KRT··X and KRT··XLL with cylindrical outer surface conform to JIS Class -0.

2) A tapped hole is provided at front side only (on left end-face in the above sketch).



**Type KR··LL**  
(with cage, sealed type)

## Accessories

| Nominal number of applied bearing | Nominal No. of grease nipple | Nominal No. of threaded plug with hexagon socket | Nominal No. of applied hexagon nut |
|-----------------------------------|------------------------------|--------------------------------------------------|------------------------------------|
| 30~35                             | JIS A-M6F                    | M6×0.75×6ℓ                                       | 1M12×1.5~1M16×1.5                  |
| 40~180                            | JIS A-PT $\frac{1}{8}$       | PT $\frac{1}{8}$ ×7ℓ                             | 1M18×1.5~1M64×3                    |

※ Table 3 on B-179 and Table 5-2 on B-180 shows the respective boundary dimensions of grease nipple and threaded plug with hexagon socket.

| Load ratings of truck |                        |                      |                        | Limiting speeds |         | Maximum tightening torque |       | Bearing numbers        |                      |                        |                      | Mass            | Stud diameter |
|-----------------------|------------------------|----------------------|------------------------|-----------------|---------|---------------------------|-------|------------------------|----------------------|------------------------|----------------------|-----------------|---------------|
| N                     |                        | kgf                  |                        | r/min           |         | N·m                       |       | Without seal           |                      | With seal              |                      | kg<br>(approx.) | mm            |
| Spherical outer ring  | Cylindrical outer ring | Spherical outer ring | Cylindrical outer ring | grease          | oil     | N·m                       | kgf·m | Cylindrical outer ring | Spherical outer ring | Cylindrical outer ring | Spherical outer ring |                 |               |
| 1 080                 | 3 400                  | 110                  | 350                    | ※19 000         | ※25 000 | 3                         | 0.3   | KRT16                  | KRT16X               | KRT16LL                | KRT16XLL             | 0.019           | 6             |
| 1 380                 | 4 050                  | 141                  | 415                    | ※15 000         | ※20 000 | 8                         | 0.8   | KRT19                  | KRT19X               | KRT19LL                | KRT19XLL             | 0.031           | 8             |
| 1 690                 | 5 150                  | 172                  | 525                    | ※12 000         | ※16 000 | 14                        | 1.4   | KRT22                  | KRT22X               | KRT22LL                | KRT22XLL             | 0.046           | 10            |
| 2 120                 | 6 100                  | 216                  | 620                    | ※12 000         | ※16 000 | 14                        | 1.4   | KRT26                  | KRT26X               | KRT26LL                | KRT26XLL             | 0.059           | 10            |
| 2 620                 | 7 700                  | 267                  | 785                    | 10 000          | ※13 000 | 20                        | 2     | KRT30                  | KRT30X               | KRT30LL                | KRT30XLL             | 0.087           | 12            |
| 2 860                 | 8 200                  | 291                  | 835                    | 10 000          | ※13 000 | 20                        | 2     | KRT32                  | KRT32X               | KRT32LL                | KRT32XLL             | 0.097           | 12            |
| 3 200                 | 11 900                 | 325                  | 1 220                  | 8 000           | ※11 000 | 52                        | 5.3   | KRT35                  | KRT35X               | KRT35LL                | KRT35XLL             | 0.169           | 16            |
| 3 850                 | 14 500                 | 390                  | 1 480                  | 7 000           | 9 000   | 76                        | 7.8   | KRT40                  | KRT40X               | KRT40LL                | KRT40XLL             | 0.248           | 18            |
| 4 700                 | 21 000                 | 480                  | 2 150                  | 6 000           | 8 000   | 98                        | 10    | KRT47                  | KRT47X               | KRT47LL                | KRT47XLL             | 0.386           | 20            |
| 5 550                 | 23 300                 | 565                  | 2 370                  | 6 000           | 8 000   | 98                        | 10    | KRT52                  | KRT52X               | KRT52LL                | KRT52XLL             | 0.461           | 20            |
| 6 950                 | 34 500                 | 710                  | 3 500                  | 5 000           | 6 500   | 178                       | 18    | KRT62                  | KRT62X               | KRT62LL                | KRT62XLL             | 0.790           | 24            |
| 8 050                 | 38 500                 | 820                  | 3 900                  | 5 000           | 6 500   | 178                       | 18    | KRT72                  | KRT72X               | KRT72LL                | KRT72XLL             | 1.04            | 24            |
| 9 800                 | 53 000                 | 1 000                | 5 400                  | 4 000           | 5 500   | 360                       | 37    | KRT80                  | KRT80X               | KRT80LL                | KRT80XLL             | 1.55            | 30            |
| 10 400                | 56 000                 | 1 060                | 5 750                  | 4 000           | 5 500   | 360                       | 37    | KRT85                  | KRT85X               | KRT85LL                | KRT85XLL             | 1.74            | 30            |
| 11 400                | 59 000                 | 1 160                | 6 100                  | 4 000           | 5 500   | 360                       | 37    | KRT90                  | KRT90X               | KRT90LL                | KRT90XLL             | 1.95            | 30            |

Remarks: The allowable running speed of Type KRT··LL and KRT··XLL with ※marked seal is approximately 10 000r/min.

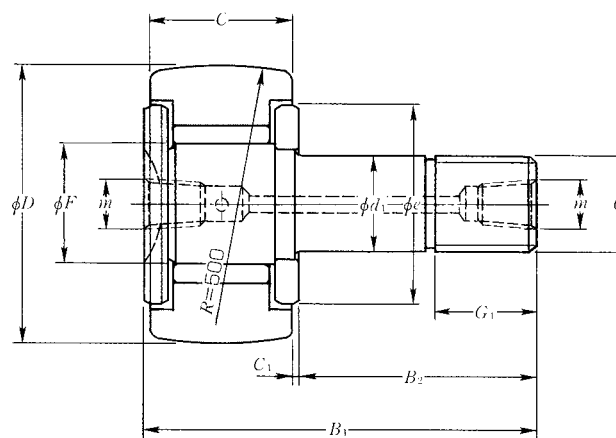
## Metric series

Type KRT

Type RT··X

Type KRT··LL

Type KRT··XLL

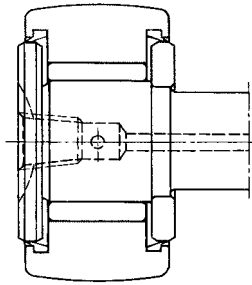
Type KRV  
(Full-complement roller type)

D 16~90mm

| Boundary dimensions |    |                                   |    |                |                |          |                |                |    |                                | Basic load ratings |                 |                |                 |
|---------------------|----|-----------------------------------|----|----------------|----------------|----------|----------------|----------------|----|--------------------------------|--------------------|-----------------|----------------|-----------------|
| mm                  |    |                                   |    |                |                |          |                |                |    |                                | dynamic            | static          | dynamic        | static          |
| D <sup>1)</sup>     | C  | d <sub>1</sub>                    | F  | B <sub>1</sub> | B <sub>2</sub> | G        | G <sub>1</sub> | C <sub>1</sub> | e  | m                              | C <sub>r</sub>     | C <sub>or</sub> | C <sub>r</sub> | C <sub>or</sub> |
| 16                  | 11 | 6 <sup>0</sup> <sub>-0.012</sub>  | 8  | 28             | 16             | M 6×1    | 8              | 0.6            | 12 | M4×0.7 <sup>2)</sup>           | 6 500              | 9 350           | 665            | 955             |
| 19                  | 11 | 8 <sup>0</sup> <sub>-0.015</sub>  | 10 | 32             | 20             | M 8×1.25 | 10             | 0.6            | 14 | M4×0.7 <sup>2)</sup>           | 7 450              | 11 700          | 760            | 1 190           |
| 22                  | 12 | 10 <sup>0</sup> <sub>-0.015</sub> | 12 | 36             | 23             | M10×1.25 | 12             | 0.6            | 17 | M4×0.7                         | 8 200              | 14 000          | 840            | 1 420           |
| 26                  | 12 | 10 <sup>0</sup> <sub>-0.015</sub> | 12 | 36             | 23             | M10×1.25 | 12             | 0.6            | 17 | M4×0.7                         | 8 200              | 14 000          | 840            | 1 420           |
| 30                  | 14 | 12 <sup>0</sup> <sub>-0.018</sub> | 15 | 40             | 25             | M12×1.5  | 13             | 0.6            | 23 | M6×0.75                        | 12 000             | 20 300          | 1 230          | 2 070           |
| 32                  | 14 | 12 <sup>0</sup> <sub>-0.018</sub> | 15 | 40             | 25             | M12×1.5  | 13             | 0.6            | 23 | M6×0.75                        | 12 000             | 20 300          | 1 230          | 2 070           |
| 35                  | 18 | 16 <sup>0</sup> <sub>-0.018</sub> | 18 | 52             | 32.5           | M16×1.5  | 17             | 0.8            | 27 | PT <sup>1</sup> / <sub>8</sub> | 17 600             | 34 000          | 1 790          | 3 500           |
| 40                  | 20 | 18 <sup>0</sup> <sub>-0.018</sub> | 22 | 58             | 36.5           | M18×1.5  | 19             | 0.8            | 32 | PT <sup>1</sup> / <sub>8</sub> | 19 400             | 42 000          | 1 980          | 4 250           |
| 47                  | 24 | 20 <sup>0</sup> <sub>-0.021</sub> | 25 | 66             | 40.5           | M20×1.5  | 21             | 0.8            | 37 | PT <sup>1</sup> / <sub>8</sub> | 28 800             | 61 000          | 2 940          | 6 250           |
| 52                  | 24 | 20 <sup>0</sup> <sub>-0.021</sub> | 25 | 66             | 40.5           | M20×1.5  | 21             | 0.8            | 37 | PT <sup>1</sup> / <sub>8</sub> | 28 800             | 61 000          | 2 940          | 6 250           |
| 62                  | 29 | 24 <sup>0</sup> <sub>-0.021</sub> | 30 | 80             | 49.5           | M24×1.5  | 25             | 0.8            | 44 | PT <sup>1</sup> / <sub>8</sub> | 39 500             | 98 500          | 4 000          | 10 000          |
| 72                  | 29 | 24 <sup>0</sup> <sub>-0.021</sub> | 30 | 80             | 49.5           | M24×1.5  | 25             | 0.8            | 44 | PT <sup>1</sup> / <sub>8</sub> | 39 500             | 98 500          | 4 000          | 10 000          |
| 80                  | 35 | 30 <sup>0</sup> <sub>-0.021</sub> | 38 | 100            | 63             | M30×1.5  | 32             | 1              | 53 | PT <sup>1</sup> / <sub>8</sub> | 58 000             | 147 000         | 5 900          | 15 000          |
| 90                  | 35 | 30 <sup>0</sup> <sub>-0.021</sub> | 38 | 100            | 63             | M30×1.5  | 32             | 1              | 53 | PT <sup>1</sup> / <sub>8</sub> | 58 000             | 147 000         | 5 900          | 15 000          |

Note 1) The dimensional tolerances for the outer ring outer diameter *D* of Type KRVT··X and KRVT··XLL with cylindrical outer surface conform to JIS Class-0.

2) A tapped hole is provided at front side only (on left end-face in the above sketch).



## Accessories

| Nominal number of applied bearing | Nominal No. of grease nipple | Nominal No. of threaded plug with hexagon socket | Nominal No. of applied hexagon nut |
|-----------------------------------|------------------------------|--------------------------------------------------|------------------------------------|
| 30~35                             | JIS A-M6F                    | M6×0.75×6ℓ                                       | 1M12×1.5~1M16×1.5                  |
| 40~180                            | JIS A-PT $\frac{1}{8}$       | PT $\frac{1}{8}$ ×7ℓ                             | 1M18×1.5~1M64×3                    |

※ Table 3 on B-179 and Table 5-2 on B-180 shows the respective boundary dimensions of grease nipple and threaded plug with hexagon socket.

**Type KRVT··LL**  
(Full-complement roller and sealed type)

| Load ratings of truck |                        |                      |                        | Limiting speeds |         | Maximum tightening torque |       | Bearing numbers        |                      |                        |                      | Mass            | Stud diameter |
|-----------------------|------------------------|----------------------|------------------------|-----------------|---------|---------------------------|-------|------------------------|----------------------|------------------------|----------------------|-----------------|---------------|
| N                     |                        | kgf                  |                        | r/min<br>grease | oil     | N·m                       | kgf·m | Without seal           |                      | With seal              |                      | kg<br>(approx.) | mm            |
| Spherical outer ring  | Cylindrical outer ring | Spherical outer ring | Cylindrical outer ring |                 |         |                           |       | Cylindrical outer ring | Spherical outer ring | Cylindrical outer ring | Spherical outer ring |                 |               |
| 1 080                 | 3 400                  | 110                  | 350                    | ※13 000         | ※16 000 | 3                         | 0.3   | KRVT16                 | KRVT16X              | KRVT16LL               | KRVT16XLL            | 0.020           | 6             |
| 1 380                 | 4 050                  | 141                  | 415                    | 10 000          | ※13 000 | 8                         | 0.8   | KRVT19                 | KRVT19X              | KRVT19LL               | KRVT19XLL            | 0.032           | 8             |
| 1 690                 | 5 150                  | 172                  | 525                    | 8 500           | ※11 000 | 14                        | 1.4   | KRVT22                 | KRVT22X              | KRVT22LL               | KRVT22XLL            | 0.047           | 10            |
| 2 120                 | 6 100                  | 216                  | 620                    | 8 500           | ※11 000 | 14                        | 1.4   | KRVT26                 | KRVT26X              | KRVT26LL               | KRVT26XLL            | 0.061           | 10            |
| 2 620                 | 7 700                  | 267                  | 785                    | 6 500           | 8 500   | 20                        | 2     | KRVT30                 | KRVT30X              | KRVT30LL               | KRVT30XLL            | 0.089           | 12            |
| 2 860                 | 8 200                  | 291                  | 835                    | 6 500           | 8 500   | 20                        | 2     | KRVT32                 | KRVT32X              | KRVT32LL               | KRVT32XLL            | 0.100           | 12            |
| 3 200                 | 11 900                 | 325                  | 1 220                  | 5 500           | 7 000   | 52                        | 5.3   | KRVT35                 | KRVT35X              | KRVT35LL               | KRVT35XLL            | 0.172           | 16            |
| 3 850                 | 14 500                 | 390                  | 1 480                  | 4 500           | 6 000   | 76                        | 7.8   | KRVT40                 | KRVT40X              | KRVT40LL               | KRVT40XLL            | 0.252           | 18            |
| 4 700                 | 21 000                 | 480                  | 2 150                  | 4 000           | 5 000   | 98                        | 10    | KRVT47                 | KRVT47X              | KRVT47LL               | KRVT47XLL            | 0.390           | 20            |
| 5 550                 | 23 300                 | 565                  | 2 370                  | 4 000           | 5 000   | 98                        | 10    | KRVT52                 | KRVT52X              | KRVT52LL               | KRVT52XLL            | 0.465           | 20            |
| 6 950                 | 34 500                 | 710                  | 3 500                  | 3 300           | 4 500   | 178                       | 18    | KRVT62                 | KRVT62X              | KRVT62LL               | KRVT62XLL            | 0.800           | 24            |
| 8 050                 | 38 500                 | 820                  | 3 900                  | 3 300           | 4 500   | 178                       | 18    | KRVT72                 | KRVT72X              | KRVT72LL               | KRVT72XLL            | 1.05            | 24            |
| 9 800                 | 53 000                 | 1 000                | 5 400                  | 2 600           | 3 500   | 360                       | 37    | KRVT80                 | KRVT80X              | KRVT80LL               | KRVT80XLL            | 1.56            | 30            |
| 11 400                | 59 000                 | 1 160                | 6 100                  | 2 600           | 3 500   | 360                       | 37    | KRVT90                 | KRVT90X              | KRVT90LL               | KRVT90XLL            | 1.97            | 30            |

Remarks: The allowable running speed of **Type KRVT··LL** and **KRVT··XLL** with ※marked seal is approximately 10 000r/min.

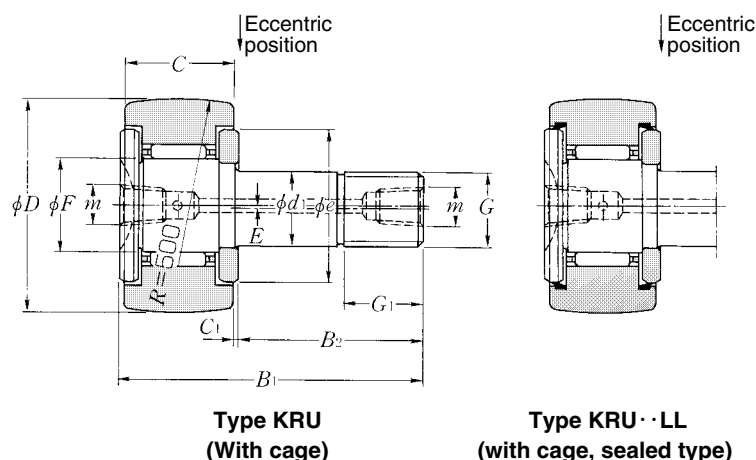
## Metric Series

Type KRU

Type KRU··LL

Type KRVU

Type KRVU··LL

Type KRU  
(With cage)Type KRU··LL  
(with cage, sealed type)

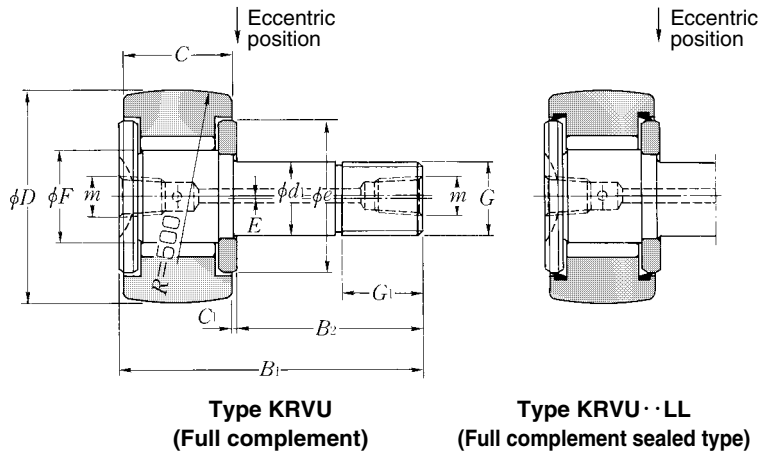
D 16~80mm

| Boundary dimensions                            |     |                                                 |     |       |       |          |    |       |       |                      |      |                     | Basic load ratings |          |         |          |
|------------------------------------------------|-----|-------------------------------------------------|-----|-------|-------|----------|----|-------|-------|----------------------|------|---------------------|--------------------|----------|---------|----------|
| $\begin{matrix} D \\ 0 \\ -0.050 \end{matrix}$ | $C$ | $d_1$                                           | $F$ | $B_1$ | $B_2$ | mm       |    | $G_1$ | $C_1$ | $e$                  | $m$  | $E$<br>eccentricity | dynamic            | static   | dynamic | static   |
|                                                |     |                                                 |     |       |       | $N$      |    |       |       |                      |      |                     | kgf                |          |         |          |
|                                                |     |                                                 |     |       |       | $G$      |    |       |       |                      |      |                     | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ |
| 16                                             | 11  | $\begin{matrix} 6 \\ 0 \\ -0.012 \end{matrix}$  | 8   | 28    | 16    | M 6×1    | 8  | 0.6   | 12    | M4×0.7 <sup>2)</sup> | 0.25 |                     | 4 050              | 4 200    | 415     | 430      |
|                                                | 11  | $\begin{matrix} 6 \\ -0.012 \end{matrix}$       | 8   | 28    | 16    | M 6×1    | 8  | 0.6   | 12    | M4×0.7 <sup>2)</sup> | 0.25 |                     | 6 500              | 9 350    | 665     | 955      |
| 19                                             | 11  | $\begin{matrix} 8 \\ 0 \\ -0.015 \end{matrix}$  | 10  | 32    | 20    | M 8×1.25 | 10 | 0.6   | 14    | M4×0.7 <sup>2)</sup> | 0.25 |                     | 4 750              | 5 400    | 480     | 555      |
|                                                | 11  | $\begin{matrix} 8 \\ -0.015 \end{matrix}$       | 10  | 32    | 20    | M 8×1.25 | 10 | 0.6   | 14    | M4×0.7 <sup>2)</sup> | 0.25 |                     | 7 450              | 11 700   | 760     | 1 190    |
| 22                                             | 12  | $\begin{matrix} 10 \\ 0 \\ -0.015 \end{matrix}$ | 12  | 36    | 23    | M10×1.25 | 12 | 0.6   | 17    | M4×0.7               | 0.3  |                     | 5 300              | 6 650    | 540     | 680      |
|                                                | 12  | $\begin{matrix} 10 \\ -0.015 \end{matrix}$      | 12  | 36    | 23    | M10×1.25 | 12 | 0.6   | 17    | M4×0.7               | 0.3  |                     | 8 200              | 14 000   | 840     | 1 420    |
| 26                                             | 12  | $\begin{matrix} 10 \\ 0 \\ -0.015 \end{matrix}$ | 12  | 36    | 23    | M10×1.25 | 12 | 0.6   | 17    | M4×0.7               | 0.3  |                     | 5 300              | 6 650    | 540     | 680      |
|                                                | 12  | $\begin{matrix} 10 \\ -0.015 \end{matrix}$      | 12  | 36    | 23    | M10×1.25 | 12 | 0.6   | 17    | M4×0.7               | 0.3  |                     | 8 200              | 14 000   | 840     | 1 420    |
| 30                                             | 14  | $\begin{matrix} 12 \\ 0 \\ -0.018 \end{matrix}$ | 15  | 40    | 25    | M12×1.5  | 13 | 0.6   | 23    | M6×0.75              | 0.4  |                     | 7 850              | 9 650    | 800     | 985      |
|                                                | 14  | $\begin{matrix} 12 \\ -0.018 \end{matrix}$      | 15  | 40    | 25    | M12×1.5  | 13 | 0.6   | 23    | M6×0.75              | 0.4  |                     | 12 000             | 20 300   | 1 230   | 2 070    |
| 32                                             | 14  | $\begin{matrix} 12 \\ 0 \\ -0.018 \end{matrix}$ | 15  | 40    | 25    | M12×1.5  | 13 | 0.6   | 23    | M6×0.75              | 0.4  |                     | 7 850              | 9 650    | 800     | 985      |
|                                                | 14  | $\begin{matrix} 12 \\ -0.018 \end{matrix}$      | 15  | 40    | 25    | M12×1.5  | 13 | 0.6   | 23    | M6×0.75              | 0.4  |                     | 12 000             | 20 300   | 1 230   | 2 070    |
| 35                                             | 18  | $\begin{matrix} 16 \\ 0 \\ -0.018 \end{matrix}$ | 18  | 52    | 32.5  | M16×1.5  | 17 | 0.8   | 27    | M6×0.75              | 0.5  |                     | 12 500             | 18 900   | 1 280   | 1 930    |
|                                                | 18  | $\begin{matrix} 16 \\ -0.018 \end{matrix}$      | 18  | 52    | 32.5  | M16×1.5  | 17 | 0.8   | 27    | M6×0.75              | 0.5  |                     | 18 000             | 36 500   | 1 840   | 3 700    |
| 40                                             | 20  | $\begin{matrix} 18 \\ 0 \\ -0.018 \end{matrix}$ | 22  | 58    | 36.5  | M18×1.5  | 19 | 0.8   | 32    | PT $\frac{1}{8}$     | 0.6  |                     | 14 000             | 22 800   | 1 430   | 2 330    |
|                                                | 20  | $\begin{matrix} 18 \\ -0.018 \end{matrix}$      | 22  | 58    | 36.5  | M18×1.5  | 19 | 0.8   | 32    | PT $\frac{1}{8}$     | 0.6  |                     | 19 400             | 42 000   | 1 980   | 4 250    |
| 47                                             | 24  | $\begin{matrix} 20 \\ 0 \\ -0.021 \end{matrix}$ | 25  | 66    | 40.5  | M20×1.5  | 21 | 0.8   | 37    | PT $\frac{1}{8}$     | 0.7  |                     | 20 700             | 33 500   | 2 110   | 3 450    |
|                                                | 24  | $\begin{matrix} 20 \\ -0.021 \end{matrix}$      | 25  | 66    | 40.5  | M20×1.5  | 21 | 0.8   | 37    | PT $\frac{1}{8}$     | 0.7  |                     | 28 800             | 61 000   | 2 940   | 6 250    |
| 52                                             | 24  | $\begin{matrix} 20 \\ 0 \\ -0.021 \end{matrix}$ | 25  | 66    | 40.5  | M20×1.5  | 21 | 0.8   | 37    | PT $\frac{1}{8}$     | 0.7  |                     | 20 700             | 33 500   | 2 110   | 3 450    |
|                                                | 24  | $\begin{matrix} 20 \\ -0.021 \end{matrix}$      | 25  | 66    | 40.5  | M20×1.5  | 21 | 0.8   | 37    | PT $\frac{1}{8}$     | 0.7  |                     | 28 800             | 61 000   | 2 940   | 6 250    |
| 62                                             | 29  | $\begin{matrix} 24 \\ 0 \\ -0.021 \end{matrix}$ | 30  | 80    | 49.5  | M24×1.5  | 25 | 0.8   | 44    | PT $\frac{1}{8}$     | 0.8  |                     | 28 900             | 55 000   | 2 950   | 5 600    |
|                                                | 29  | $\begin{matrix} 24 \\ -0.021 \end{matrix}$      | 30  | 80    | 49.5  | M24×1.5  | 25 | 0.8   | 44    | PT $\frac{1}{8}$     | 0.8  |                     | 39 500             | 98 500   | 4 000   | 10 000   |
| 72                                             | 29  | $\begin{matrix} 24 \\ 0 \\ -0.021 \end{matrix}$ | 30  | 80    | 49.5  | M24×1.5  | 25 | 0.8   | 44    | PT $\frac{1}{8}$     | 0.8  |                     | 28 900             | 55 000   | 2 950   | 5 600    |
|                                                | 29  | $\begin{matrix} 24 \\ -0.021 \end{matrix}$      | 30  | 80    | 49.5  | M24×1.5  | 25 | 0.8   | 44    | PT $\frac{1}{8}$     | 0.8  |                     | 39 500             | 98 500   | 4 000   | 10 000   |
| 80                                             | 35  | $\begin{matrix} 30 \\ 0 \\ -0.021 \end{matrix}$ | 38  | 100   | 63    | M30×1.5  | 32 | 1     | 53    | PT $\frac{1}{8}$     | 1.0  |                     | 45 000             | 88 500   | 4 600   | 9 050    |
|                                                | 35  | $\begin{matrix} 30 \\ -0.021 \end{matrix}$      | 38  | 100   | 63    | M30×1.5  | 32 | 1     | 53    | PT $\frac{1}{8}$     | 1.0  |                     | 58 000             | 147 000  | 5 900   | 15 000   |

Note 1) For bearing with cylindrical outer surface, the nominal number is followed by "X" code. In this case, the cylindrical bearing is manufactured with the tolerance for outer ring outer diameter *D* which conforms to JIS Class-0. Ex. KRU52XLL

2) A tapped hole is provided at front side only (on left side-face in the above sketch).





## Accessories

| Nominal number of applied bearing | Nominal No. of grease nipple | Nominal No. of threaded plug with hexagon socket | Nominal No. of applied hexagon nut |
|-----------------------------------|------------------------------|--------------------------------------------------|------------------------------------|
| 16~26                             | NIP-X30                      | M4×0.7 ×4ℓ                                       | 1M 6×1 ~1M10×1.25                  |
| 30~35                             | JIS A-M6F                    | M6×0.75×6ℓ                                       | 1M12×1.5~1M16×1.5                  |
| 40~90                             | JIS A-PT $\frac{1}{8}$       | PT $\frac{1}{8}$ ×7ℓ                             | 1M18×1.5~1M30×1.5                  |

※ Table 3 on B-179 and Table 5-2 on B-180 shows the respective boundary dimensions of grease nipple and threaded plug with hexagon socket.

| Load ratings of truck  |                      |                        |                      | Limiting speeds |         | Maximum tightening torque |       | Bearing numbers                     |                                               | Mass (approx.) kg |           |
|------------------------|----------------------|------------------------|----------------------|-----------------|---------|---------------------------|-------|-------------------------------------|-----------------------------------------------|-------------------|-----------|
| N                      |                      |                        |                      | r/min           |         | N·m                       |       | Type KRU <sup>1)</sup><br>Type KRVU | Type KRU...LL <sup>1)</sup><br>Type KRVU...LL | Type KRU          | Type KRVU |
| Cylindrical outer ring | Spherical outer ring | Cylindrical outer ring | Spherical outer ring | grease          | oil     |                           | kgf·m |                                     |                                               |                   |           |
| 1 080                  | 3 400                | 110                    | 350                  | ※19 000         | ※25 000 | 3                         | 0.3   | KRU16                               | KRU16LL                                       | 0.019             | —         |
| 1 080                  | 3 400                | 110                    | 350                  | ※13 000         | ※16 000 | 3                         | 0.3   | KRVU16                              | KRVU16LL                                      | —                 | 0.020     |
| 1 380                  | 4 050                | 141                    | 415                  | ※15 000         | ※20 000 | 8                         | 0.8   | KRU19                               | KRU19LL                                       | 0.031             | —         |
| 1 380                  | 4 050                | 141                    | 415                  | 10 000          | ※13 000 | 8                         | 0.8   | KRVU19                              | KRVU19LL                                      | —                 | 0.032     |
| 1 690                  | 5 150                | 172                    | 525                  | ※12 000         | ※16 000 | 14                        | 1.4   | KRU22                               | KRU22LL                                       | 0.046             | —         |
| 1 690                  | 5 150                | 172                    | 525                  | 8 500           | ※11 000 | 14                        | 1.4   | KRVU22                              | KRVU22LL                                      | —                 | 0.047     |
| 2 120                  | 6 100                | 216                    | 620                  | ※12 000         | ※16 000 | 14                        | 1.4   | KRU26                               | KRU26LL                                       | 0.059             | —         |
| 2 120                  | 6 100                | 216                    | 620                  | 8 500           | ※11 000 | 14                        | 1.4   | KRVU26                              | KRVU26LL                                      | —                 | 0.061     |
| 2 620                  | 7 700                | 267                    | 785                  | 10 000          | ※13 000 | 20                        | 2     | KRU30                               | KRU30LL                                       | 0.087             | —         |
| 2 620                  | 7 700                | 267                    | 785                  | 6 500           | 8 500   | 20                        | 2     | KRVU30                              | KRVU30LL                                      | —                 | 0.089     |
| 2 860                  | 8 200                | 291                    | 835                  | 10 000          | ※13 000 | 20                        | 2     | KRU32                               | KRU32LL                                       | 0.097             | —         |
| 2 860                  | 8 200                | 291                    | 835                  | 6 500           | 8 500   | 20                        | 2     | KRVU32                              | KRVU32LL                                      | —                 | 0.100     |
| 3 200                  | 11 900               | 325                    | 1 220                | 8 000           | ※11 000 | 52                        | 5.3   | KRU35                               | KRU35LL                                       | 0.169             | —         |
| 3 200                  | 11 900               | 325                    | 1 220                | 5 500           | 7 000   | 52                        | 5.3   | KRVU35                              | KRVU35LL                                      | —                 | 0.172     |
| 3 850                  | 14 500               | 390                    | 1 480                | 7 000           | 9 000   | 76                        | 7.8   | KRU40                               | KRU40LL                                       | 0.248             | —         |
| 3 850                  | 14 500               | 390                    | 1 480                | 4 500           | 6 000   | 76                        | 7.8   | KRVU40                              | KRVU40LL                                      | —                 | 0.252     |
| 4 700                  | 21 000               | 480                    | 2 150                | 6 000           | 8 000   | 98                        | 10    | KRU47                               | KRU47LL                                       | 0.386             | —         |
| 4 700                  | 21 000               | 480                    | 2 150                | 4 000           | 5 000   | 98                        | 10    | KRVU47                              | KRVU47LL                                      | —                 | 0.390     |
| 5 550                  | 23 300               | 565                    | 2 370                | 6 000           | 8 000   | 98                        | 10    | KRU52                               | KRU52LL                                       | 0.461             | —         |
| 5 550                  | 23 300               | 565                    | 2 370                | 4 000           | 5 000   | 98                        | 10    | KRVU52                              | KRVU52LL                                      | —                 | 0.465     |
| 6 950                  | 34 500               | 710                    | 3 500                | 5 000           | 6 500   | 178                       | 18    | KRU62                               | KRU62LL                                       | 0.790             | —         |
| 6 950                  | 34 500               | 710                    | 3 500                | 3 300           | 4 500   | 178                       | 18    | KRVU62                              | KRVU62LL                                      | —                 | 0.800     |
| 8 050                  | 38 500               | 820                    | 3 900                | 5 000           | 6 500   | 178                       | 18    | KRU72                               | KRU72LL                                       | 1.04              | —         |
| 8 050                  | 38 500               | 820                    | 3 900                | 3 300           | 4 500   | 178                       | 18    | KRVU72                              | KRVU72LL                                      | —                 | 1.05      |
| 9 800                  | 53 000               | 1 000                  | 5 400                | 4 000           | 5 500   | 360                       | 37    | KRU80                               | KRU80LL                                       | 1.55              | —         |
| 9 800                  | 53 000               | 1 000                  | 5 400                | 2 600           | 3 500   | 360                       | 37    | KRVU80                              | KRVU80LL                                      | —                 | 1.56      |

Remarks: For the cam follower with ※marked seal, the allowable running speed is approximately 10 000 r/min.

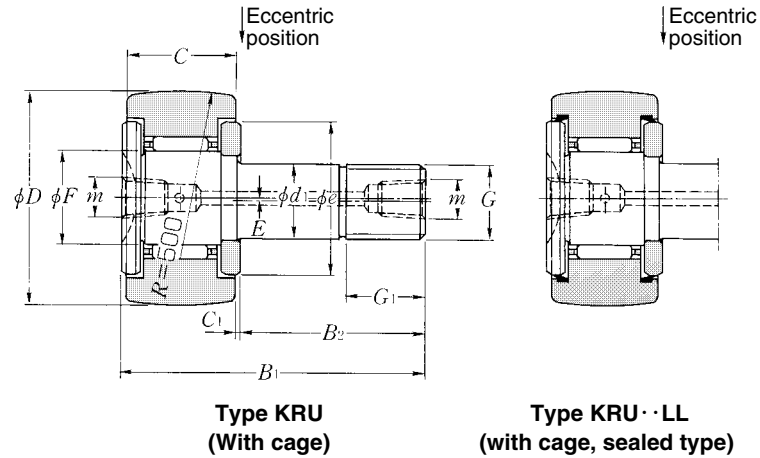
## Metric Series

Type KRU

Type KRU··LL

Type KRVU

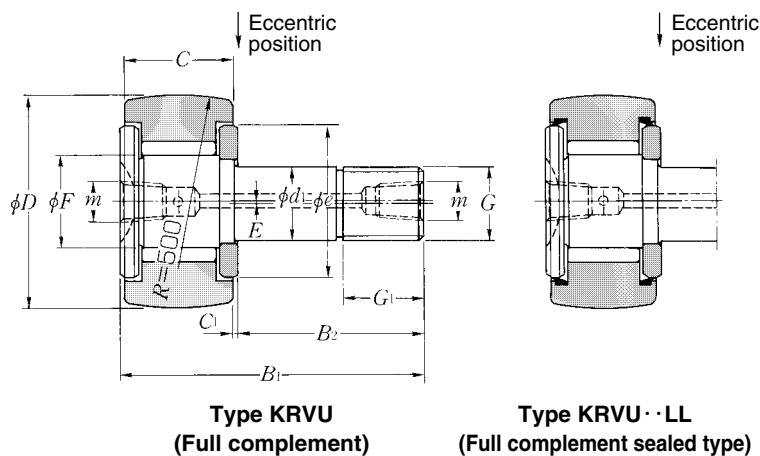
Type KRVU··LL



D 85~90mm

| Boundary dimensions                                 |    |                                                        |    |                |                |         |                |                |    |                  |                   |  | Basic load ratings |                 |                |                 |
|-----------------------------------------------------|----|--------------------------------------------------------|----|----------------|----------------|---------|----------------|----------------|----|------------------|-------------------|--|--------------------|-----------------|----------------|-----------------|
| D                                                   | C  | d <sub>1</sub>                                         | F  | B <sub>1</sub> | B <sub>2</sub> | mm<br>G | G <sub>1</sub> | C <sub>1</sub> | e  | m                | E<br>eccentricity |  | dynamic<br>N       | static          | dynamic        | static          |
| $\begin{smallmatrix} 0 \\ -0.050 \end{smallmatrix}$ |    |                                                        |    |                |                |         |                |                |    |                  |                   |  | C <sub>r</sub>     | C <sub>or</sub> | C <sub>r</sub> | C <sub>or</sub> |
| 85                                                  | 35 | 30 $\begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$ | 38 | 100            | 63             | M30×1.5 | 32             | 1              | 53 | PT $\frac{1}{8}$ | 1.0               |  | 45 000             | 88 500          | 4 600          | 9 050           |
| 90                                                  | 35 | 30 $\begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$ | 38 | 100            | 63             | M30×1.5 | 32             | 1              | 53 | PT $\frac{1}{8}$ | 1.0               |  | 45 000             | 88 500          | 4 600          | 9 050           |
|                                                     | 35 | 30 $\begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$ | 38 | 100            | 63             | M30×1.5 | 32             | 1              | 53 | PT $\frac{1}{8}$ | 1.0               |  | 58 000             | 147 000         | 5 900          | 15 000          |

Note 1) For bearing with cylindrical outer surface, the nominal number is followed by "X" code. In this case, the cylindrical bearing is manufactured with the tolerance for outer ring outer diameter *D* which conforms to JIS Class-0. Ex. KRU85XLL



#### Accessories

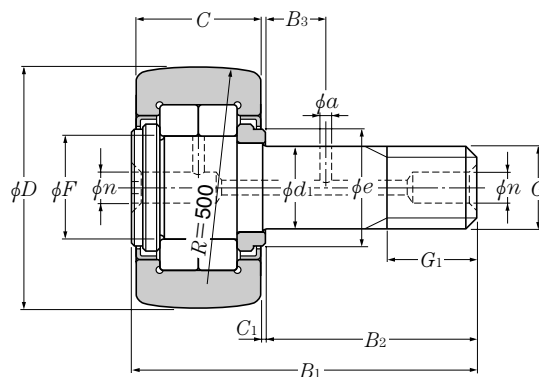
| Nominal number of applied bearing | Nominal No. of grease nipple | Nominal No. of threaded plug with hexagon socket | Nominal No. of applied hexagon nut |
|-----------------------------------|------------------------------|--------------------------------------------------|------------------------------------|
| 16~26                             | NIP-X30                      | M4×0.7 ×4ℓ                                       | 1M 6×1 ~1M10×1.25                  |
| 30~35                             | JIS A-M6F                    | M6×0.75×6ℓ                                       | 1M12×1.5~1M16×1.5                  |
| 40~90                             | JIS A-PT $\frac{1}{8}$       | PT $\frac{1}{8}$ ×7 ℓ                            | 1M18×1.5~1M30×1.5                  |

※Table 3 on B-179 and Table 5-2 on B-180 shows the respective boundary dimensions of grease nipple and threaded plug with hexagon socket.

| Load ratings of truck  |                      |                        |                      | Limiting speeds |       | Maximum tightening torque |       | Bearing numbers                     |                                             | Mass (approx.) kg |           |
|------------------------|----------------------|------------------------|----------------------|-----------------|-------|---------------------------|-------|-------------------------------------|---------------------------------------------|-------------------|-----------|
| N                      |                      | kgf                    |                      | r/min           |       | N·m                       |       | Type KRU <sup>1)</sup><br>Type KRVU | Type KRU··LL <sup>1)</sup><br>Type KRVU··LL | Type KRU          | Type KRVU |
| Cylindrical outer ring | Spherical outer ring | Cylindrical outer ring | Spherical outer ring | grease          | oil   |                           | kgf·m |                                     |                                             |                   |           |
| 10 400                 | 56 000               | 1 060                  | 5 750                | 4 000           | 5 500 | 360                       | 37    | KRU85                               | KRU85LL                                     | 1.74              | —         |
| 11 400                 | 59 000               | 1 160                  | 6 100                | 4 000           | 5 500 | 360                       | 37    | KRU90                               | KRU90LL                                     | 1.95              | —         |
| 11 400                 | 59 000               | 1 160                  | 6 100                | 2 600           | 3 500 | 360                       | 37    | KRVU90                              | KRVU90LL                                    | —                 | 1.97      |

## Metric Series

## Type NUKR

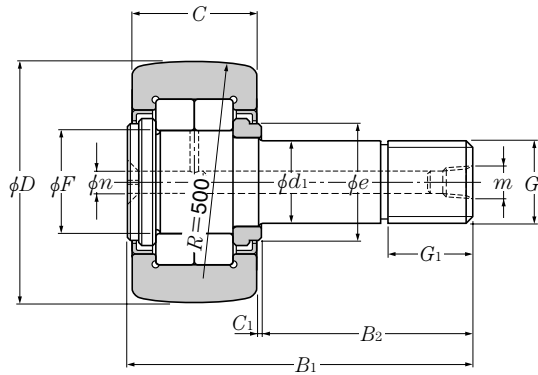
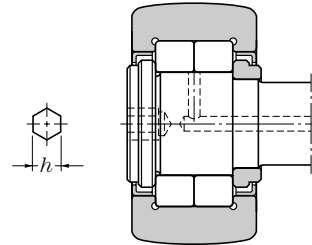
Type NUKR ( $D < 100\text{mm}$ ) (Double row type full complement with seal)

D 30~180mm

## Boundary dimensions

| D<br>$\begin{smallmatrix} 0 \\ -0.050 \end{smallmatrix}$ | C  | $d_1$                                                  | F    | $B_1$ | $B_2$ | mm      |    | $G_1$ | $C_1$ | n        | m  | $B_3$ | a     | e  | h |
|----------------------------------------------------------|----|--------------------------------------------------------|------|-------|-------|---------|----|-------|-------|----------|----|-------|-------|----|---|
|                                                          |    |                                                        |      |       |       | G       | G  |       |       |          |    |       |       |    |   |
| 30                                                       | 14 | $12 \begin{smallmatrix} 0 \\ -0.018 \end{smallmatrix}$ | 14.5 | 40    | 25    | M12×1.5 | 13 | 0.6   | 6     | —        | 6  | 3     | 15    | 6  |   |
| 35                                                       | 18 | $16 \begin{smallmatrix} 0 \\ -0.018 \end{smallmatrix}$ | 19   | 52    | 32.5  | M16×1.5 | 17 | 0.8   | 6     | —        | 8  | 3     | 21    | 6  |   |
| 40                                                       | 20 | $18 \begin{smallmatrix} 0 \\ -0.018 \end{smallmatrix}$ | 21.5 | 58    | 36.5  | M18×1.5 | 19 | 0.8   | 6     | —        | 8  | 3     | 23    | 6  |   |
| 47                                                       | 24 | $20 \begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$ | 25.5 | 66    | 40.5  | M20×1.5 | 21 | 0.8   | 8     | —        | 9  | 4     | 27    | 8  |   |
| 52                                                       | 24 | $20 \begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$ | 30   | 66    | 40.5  | M20×1.5 | 21 | 0.8   | 8     | —        | 9  | 4     | 31    | 8  |   |
| 62                                                       | 29 | $24 \begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$ | 35   | 80    | 49.5  | M24×1.5 | 25 | 0.8   | 8     | —        | 11 | 4     | 38    | 8  |   |
| 72                                                       | 29 | $24 \begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$ | 41.5 | 80    | 49.5  | M24×1.5 | 25 | 0.8   | 8     | —        | 11 | 4     | 44    | 8  |   |
| 80                                                       | 35 | $30 \begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$ | 47.5 | 100   | 63    | M30×1.5 | 32 | 1     | 8     | —        | 15 | 4     | 51    | 8  |   |
| 90                                                       | 35 | $30 \begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$ | 47.5 | 100   | 63    | M30×1.5 | 32 | 1     | 8     | —        | 15 | 4     | 51    | 8  |   |
| 100                                                      | 43 | $36 \begin{smallmatrix} 0 \\ -0.025 \end{smallmatrix}$ | 48.5 | 120   | 74    | M36×1.5 | 38 | 1.5   | 8     | PT $1/8$ | —  | —     | 53    | 14 |   |
| 120                                                      | 50 | $42 \begin{smallmatrix} 0 \\ -0.025 \end{smallmatrix}$ | 60.5 | 140   | 87    | M42×1.5 | 44 | 1.5   | 8     | PT $1/8$ | —  | —     | 66    | 14 |   |
| 140                                                      | 57 | $48 \begin{smallmatrix} 0 \\ -0.025 \end{smallmatrix}$ | 65   | 160   | 100   | M48×1.5 | 52 | 1.5   | 8     | PT $1/8$ | —  | —     | 72.5  | 14 |   |
| 150                                                      | 60 | $52 \begin{smallmatrix} 0 \\ -0.030 \end{smallmatrix}$ | 75.5 | 170   | 107   | M52×1.5 | 52 | 1.5   | 8     | PT $1/8$ | —  | —     | 85.5  | 17 |   |
| 160                                                      | 63 | $56 \begin{smallmatrix} 0 \\ -0.030 \end{smallmatrix}$ | 80.5 | 180   | 113   | M56×3   | 58 | 2     | 8     | PT $1/8$ | —  | —     | 89.5  | 17 |   |
| 170                                                      | 66 | $60 \begin{smallmatrix} 0 \\ -0.030 \end{smallmatrix}$ | 86   | 190   | 120   | M60×3   | 58 | 2     | 8     | PT $1/8$ | —  | —     | 96.5  | 17 |   |
| 180                                                      | 72 | $64 \begin{smallmatrix} 0 \\ -0.030 \end{smallmatrix}$ | 91.5 | 200   | 124   | M64×3   | 65 | 2     | 8     | PT $1/8$ | —  | —     | 103.5 | 17 |   |

Note 1) For bearing with cylindrical outer surface, the nominal number is followed by "X" code. In this case, the cylindrical bearing is manufactured with the tolerance for outer ring outer diameter  $D$  which conforms to JIS Class-0. Ex. NUKR52X

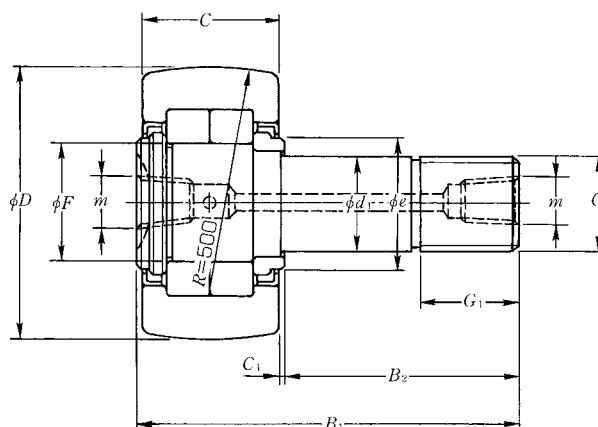
Type NUKR ( $D \geq 100\text{mm}$ )Type NUKR · · H  
(With hexagonal wrench socket)

| Basic load ratings |          |         |          | Load ratings of truck   |                           |                         |                           | Limiting<br>speeds<br>r/min<br>grease | Maximum<br>tightening<br>torque |       | Bearing<br>numbers      | Mass<br>(approx.)<br>kg<br>Type KUKR |
|--------------------|----------|---------|----------|-------------------------|---------------------------|-------------------------|---------------------------|---------------------------------------|---------------------------------|-------|-------------------------|--------------------------------------|
| dynamic            | static   | dynamic | static   | N                       |                           | kgf                     |                           |                                       | N·m                             | kgf·m |                         |                                      |
| $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ | Spherical<br>outer ring | Cylindrical<br>outer ring | Spherical<br>outer ring | Cylindrical<br>outer ring |                                       |                                 |       | Type KUKR <sup>1)</sup> |                                      |
| 13 300             | 13 500   | 1 360   | 1 380    | 2 620                   | 7 700                     | 267                     | 785                       | 6 900                                 | 20                              | 2     | NUKR 30                 | 0.088                                |
| 22 300             | 25 700   | 2 280   | 2 620    | 3 200                   | 11 900                    | 325                     | 1 220                     | 5 500                                 | 52                              | 5.3   | NUKR 35                 | 0.165                                |
| 24 100             | 29 100   | 2 450   | 2 970    | 3 850                   | 14 500                    | 390                     | 1 480                     | 4 700                                 | 76                              | 7.8   | NUKR 40                 | 0.242                                |
| 38 500             | 48 000   | 3 950   | 4 900    | 4 700                   | 21 000                    | 480                     | 2 150                     | 4 000                                 | 98                              | 10    | NUKR 47                 | 0.380                                |
| 42 500             | 57 500   | 4 350   | 5 850    | 5 550                   | 23 300                    | 565                     | 2 370                     | 3 300                                 | 98                              | 10    | NUKR 52                 | 0.450                                |
| 56 500             | 72 500   | 5 750   | 7 400    | 6 950                   | 34 500                    | 710                     | 3 500                     | 2 900                                 | 178                             | 18    | NUKR 62                 | 0.795                                |
| 62 000             | 85 500   | 6 350   | 8 700    | 8 050                   | 38 500                    | 820                     | 3 900                     | 2 400                                 | 178                             | 18    | NUKR 72                 | 1.01                                 |
| 101 000            | 151 000  | 10 300  | 15 400   | 9 800                   | 53 000                    | 1 000                   | 5 400                     | 2 100                                 | 360                             | 37    | NUKR 80                 | 1.54                                 |
| 101 000            | 151 000  | 10 300  | 15 400   | 11 400                  | 59 000                    | 1 160                   | 6 100                     | 2 100                                 | 360                             | 37    | NUKR 90                 | 1.96                                 |
| 119 000            | 167 000  | 12 100  | 17 000   | 13 000                  | 79 000                    | 1 300                   | 8 050                     | 2 000                                 | 630                             | 65    | NUKR100                 | 3.08                                 |
| 172 000            | 266 000  | 17 600  | 27 100   | 16 400                  | 113 000                   | 1 670                   | 11 500                    | 1 700                                 | 1 020                           | 105   | NUKR120                 | 5.17                                 |
| 201 000            | 294 000  | 20 500  | 30 000   | 20 000                  | 152 000                   | 2 040                   | 15 500                    | 1 500                                 | 1 540                           | 160   | NUKR140                 | 7.98                                 |
| 258 000            | 380 000  | 26 300  | 39 000   | 22 000                  | 173 000                   | 2 250                   | 17 600                    | 1 300                                 | 1 950                           | 200   | NUKR150                 | 9.70                                 |
| 274 000            | 400 000  | 27 900  | 41 000   | 24 000                  | 194 000                   | 2 450                   | 19 800                    | 1 200                                 | 2 480                           | 250   | NUKR160                 | 11.7                                 |
| 320 000            | 475 000  | 32 500  | 48 500   | 26 000                  | 218 000                   | 2 650                   | 22 200                    | 1 100                                 | 3 030                           | 310   | NUKR170                 | 13.9                                 |
| 365 000            | 555 000  | 37 500  | 56 500   | 27 900                  | 253 000                   | 2 840                   | 25 800                    | 1 000                                 | 3 670                           | 375   | NUKR180                 | 17.0                                 |

## Metric Series

## Type NUKRT

## Type NUKRT··X



Type NUKRT

(Shielded full-complement roller, double-row cylindrical roller type)

D 30~180mm

| Boundary dimensions |    |                                   |      |                |      |         |    |                |                |                                |   | Basic load ratings |                 |                |                 |
|---------------------|----|-----------------------------------|------|----------------|------|---------|----|----------------|----------------|--------------------------------|---|--------------------|-----------------|----------------|-----------------|
| D <sup>1)</sup>     | C  | d <sub>1</sub>                    | F    | B <sub>1</sub> | mm   |         | G  | G <sub>1</sub> | C <sub>1</sub> | e                              | m | dynamic            | static          | dynamic        | static          |
|                     |    |                                   |      |                | N    | kgf     |    |                |                |                                |   | C <sub>r</sub>     | C <sub>or</sub> | C <sub>r</sub> | C <sub>or</sub> |
| 30                  | 14 | 12 <sup>0</sup> <sub>−0.018</sub> | 14.5 | 40             | 25   | M12×1.5 | 13 | 0.6            | 15             | M6×0.75                        |   | 13 300             | 13 500          | 1 360          | 1 380           |
| 35                  | 18 | 16 <sup>0</sup> <sub>−0.018</sub> | 19   | 52             | 32.5 | M16×1.5 | 17 | 0.8            | 21             | PT <sup>1</sup> / <sub>8</sub> |   | 22 300             | 25 700          | 2 280          | 2 620           |
| 40                  | 20 | 18 <sup>0</sup> <sub>−0.018</sub> | 21.5 | 58             | 36.5 | M18×1.5 | 19 | 0.8            | 23             | PT <sup>1</sup> / <sub>8</sub> |   | 24 100             | 29 100          | 2 450          | 2 970           |
| 47                  | 24 | 20 <sup>0</sup> <sub>−0.021</sub> | 25.5 | 66             | 40.5 | M20×1.5 | 21 | 0.8            | 27             | PT <sup>1</sup> / <sub>8</sub> |   | 38 500             | 48 000          | 3 950          | 4 900           |
| 52                  | 24 | 20 <sup>0</sup> <sub>−0.021</sub> | 30   | 66             | 40.5 | M20×1.5 | 21 | 0.8            | 31             | PT <sup>1</sup> / <sub>8</sub> |   | 42 500             | 57 500          | 4 350          | 5 850           |
| 62                  | 29 | 24 <sup>0</sup> <sub>−0.021</sub> | 35   | 80             | 49.5 | M24×1.5 | 25 | 0.8            | 38             | PT <sup>1</sup> / <sub>8</sub> |   | 56 500             | 72 500          | 5 750          | 7 400           |
| 72                  | 29 | 24 <sup>0</sup> <sub>−0.021</sub> | 41.5 | 80             | 49.5 | M24×1.5 | 25 | 0.8            | 44             | PT <sup>1</sup> / <sub>8</sub> |   | 62 000             | 85 500          | 6 350          | 8 700           |
| 80                  | 35 | 30 <sup>0</sup> <sub>−0.021</sub> | 47.5 | 100            | 63   | M30×1.5 | 32 | 1              | 51             | PT <sup>1</sup> / <sub>8</sub> |   | 101 000            | 151 000         | 10 300         | 15 400          |
| 90                  | 35 | 30 <sup>0</sup> <sub>−0.021</sub> | 47.5 | 100            | 63   | M30×1.5 | 32 | 1              | 51             | PT <sup>1</sup> / <sub>8</sub> |   | 101 000            | 151 000         | 10 300         | 15 400          |
| 100                 | 43 | 36 <sup>0</sup> <sub>−0.025</sub> | 48.5 | 120            | 74   | M36×1.5 | 38 | 1.5            | 53             | PT <sup>1</sup> / <sub>8</sub> |   | 119 000            | 167 000         | 12 100         | 17 000          |
| 120                 | 50 | 42 <sup>0</sup> <sub>−0.025</sub> | 60.5 | 140            | 87   | M42×1.5 | 44 | 1.5            | 66             | PT <sup>1</sup> / <sub>8</sub> |   | 172 000            | 266 000         | 17 600         | 27 100          |
| 140                 | 57 | 48 <sup>0</sup> <sub>−0.025</sub> | 65   | 160            | 100  | M48×1.5 | 52 | 1.5            | 72.5           | PT <sup>1</sup> / <sub>8</sub> |   | 201 000            | 294 000         | 20 500         | 30 000          |
| 150                 | 60 | 52 <sup>0</sup> <sub>−0.030</sub> | 75.5 | 170            | 107  | M52×1.5 | 52 | 1.5            | 85.5           | PT <sup>1</sup> / <sub>8</sub> |   | 258 000            | 380 000         | 26 300         | 39 000          |
| 160                 | 63 | 56 <sup>0</sup> <sub>−0.030</sub> | 80.5 | 180            | 113  | M56×3   | 58 | 2              | 89.5           | PT <sup>1</sup> / <sub>8</sub> |   | 274 000            | 400 000         | 27 900         | 41 000          |
| 170                 | 66 | 60 <sup>0</sup> <sub>−0.030</sub> | 86   | 190            | 120  | M60×3   | 58 | 2              | 96.5           | PT <sup>1</sup> / <sub>8</sub> |   | 320 000            | 475 000         | 32 500         | 48 500          |
| 180                 | 72 | 64 <sup>0</sup> <sub>−0.030</sub> | 91.5 | 200            | 124  | M64×3   | 65 | 2              | 103.5          | PT <sup>1</sup> / <sub>8</sub> |   | 365 000            | 555 000         | 37 500         | 56 500          |

Note 1) The dimensional tolerance for the outer ring outer diameter D of Type NUKRT··X with cylindrical outer surface conforms to JIS Class-0.

## Accessories

| Nominal number of applied bearing | Nominal No. of grease nipple | Nominal No. of threaded plug with hexagon socket | Nominal No. of applied hexagon nut |
|-----------------------------------|------------------------------|--------------------------------------------------|------------------------------------|
| 30                                | JIS A-M6F                    | M6×0.75×6ℓ                                       | 1M12×1.5                           |
| 35~180                            | JIS A-PT $\frac{1}{8}$       | PT $\frac{1}{8}$ ×7ℓ                             | 1M16×1.5~1M64×3                    |

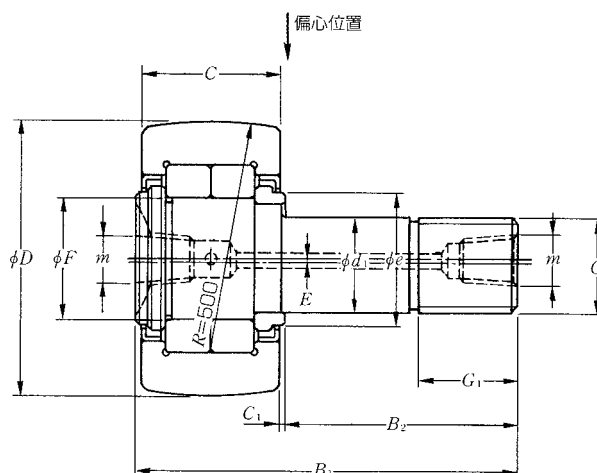
※Table 3 on B-179 and Table 5-2 on B-180 shows the respective boundary dimensions of grease nipple and threaded plug with hexagon socket.

| Load ratings of truck   |                           |                         |                           | Limiting speeds<br>r/min<br>grease | Maximum<br>tightening torque |       | Bearing numbers           |                         | Mass      | Stud<br>diameter |
|-------------------------|---------------------------|-------------------------|---------------------------|------------------------------------|------------------------------|-------|---------------------------|-------------------------|-----------|------------------|
| N                       |                           | kgf                     |                           |                                    | N·m                          | kgf·m | Cylindrical<br>outer ring | Spherical<br>outer ring | kg        | mm               |
| Spherical<br>outer ring | Cylindrical<br>outer ring | Spherical<br>outer ring | Cylindrical<br>outer ring |                                    |                              |       |                           |                         | (approx.) |                  |
| 2 620                   | 7 700                     | 267                     | 785                       | 6 900                              | 20                           | 2     | NUKRT30                   | NUKRT30X                | 0.088     | 12               |
| 3 200                   | 11 900                    | 325                     | 1 220                     | 5 500                              | 52                           | 5.3   | NUKRT35                   | NUKRT35X                | 0.165     | 16               |
| 3 850                   | 14 500                    | 390                     | 1 480                     | 4 700                              | 76                           | 7.8   | NUKRT40                   | NUKRT40X                | 0.242     | 18               |
| 4 700                   | 21 000                    | 480                     | 2 150                     | 4 000                              | 98                           | 10    | NUKRT47                   | NUKRT47X                | 0.380     | 20               |
| 5 550                   | 23 300                    | 565                     | 2 370                     | 3 300                              | 98                           | 10    | NUKRT52                   | NUKRT52X                | 0.450     | 20               |
| 6 950                   | 34 500                    | 710                     | 3 500                     | 2 900                              | 178                          | 18    | NUKRT62                   | NUKRT62X                | 0.795     | 24               |
| 8 050                   | 38 500                    | 820                     | 3 900                     | 2 400                              | 178                          | 18    | NUKRT72                   | NUKRT72X                | 1.01      | 24               |
| 9 800                   | 53 000                    | 1 000                   | 5 400                     | 2 100                              | 360                          | 37    | NUKRT80                   | NUKRT80X                | 1.54      | 30               |
| 11 400                  | 59 000                    | 1 160                   | 6 100                     | 2 100                              | 360                          | 37    | NUKRT90                   | NUKRT90X                | 1.96      | 30               |
| 13 000                  | 79 000                    | 1 300                   | 8 050                     | 2 000                              | 630                          | 65    | NUKRT100                  | NUKRT100X               | 3.08      | 36               |
| 16 400                  | 113 000                   | 1 670                   | 11 500                    | 1 700                              | 1 020                        | 105   | NUKRT120                  | NUKRT120X               | 5.17      | 42               |
| 20 000                  | 152 000                   | 2 040                   | 15 500                    | 1 500                              | 1 540                        | 160   | NUKRT140                  | NUKRT140X               | 7.98      | 48               |
| 22 000                  | 173 000                   | 2 250                   | 17 600                    | 1 300                              | 1 950                        | 200   | NUKRT150                  | NUKRT150X               | 9.70      | 52               |
| 24 000                  | 194 000                   | 2 450                   | 19 800                    | 1 200                              | 2 480                        | 250   | NUKRT160                  | NUKRT160X               | 11.7      | 56               |
| 26 000                  | 218 000                   | 2 650                   | 22 200                    | 1 100                              | 3 030                        | 310   | NUKRT170                  | NUKRT170X               | 13.9      | 60               |
| 27 900                  | 253 000                   | 2 840                   | 25 800                    | 1 000                              | 3 670                        | 375   | NUKRT180                  | NUKRT180X               | 17.0      | 64               |

## Metric Series

## Type NUKRU

## Type NUKRU··X



Type NUKRU

(Shielded full-complement roller, double-row cylindrical roller type)

D 30~180mm

| D <sup>1)</sup> | C  | d <sub>1</sub>                                         | F    | B <sub>1</sub> | B <sub>2</sub> | Boundary dimensions<br>mm |                |                |       |                  |                   |  | Basic load ratings<br>dynamic static<br>N |                 |
|-----------------|----|--------------------------------------------------------|------|----------------|----------------|---------------------------|----------------|----------------|-------|------------------|-------------------|--|-------------------------------------------|-----------------|
|                 |    |                                                        |      |                |                | G                         | G <sub>1</sub> | C <sub>1</sub> | e     | m                | E<br>eccentricity |  | C <sub>r</sub>                            | C <sub>or</sub> |
| 30              | 14 | 12 $\begin{smallmatrix} 0 \\ -0.018 \end{smallmatrix}$ | 14.5 | 40             | 25             | M12×1.5                   | 13             | 0.6            | 15    | M6×0.75          | 0.4               |  | 13 300                                    | 13 500          |
| 35              | 18 | 16 $\begin{smallmatrix} 0 \\ -0.018 \end{smallmatrix}$ | 19   | 52             | 32.5           | M16×1.5                   | 17             | 0.8            | 21    | M6×0.75          | 0.5               |  | 22 300                                    | 25 700          |
| 40              | 20 | 18 $\begin{smallmatrix} 0 \\ -0.018 \end{smallmatrix}$ | 21.5 | 58             | 36.5           | M18×1.5                   | 19             | 0.8            | 23    | PT $\frac{1}{8}$ | 0.6               |  | 24 100                                    | 29 100          |
| 47              | 24 | 20 $\begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$ | 25.5 | 66             | 40.5           | M20×1.5                   | 21             | 0.8            | 27    | PT $\frac{1}{8}$ | 0.7               |  | 38 500                                    | 48 000          |
| 52              | 24 | 20 $\begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$ | 30   | 66             | 40.5           | M20×1.5                   | 21             | 0.8            | 31    | PT $\frac{1}{8}$ | 0.7               |  | 42 500                                    | 57 500          |
| 62              | 29 | 24 $\begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$ | 35   | 80             | 49.5           | M24×1.5                   | 25             | 0.8            | 38    | PT $\frac{1}{8}$ | 0.8               |  | 56 500                                    | 72 500          |
| 72              | 29 | 24 $\begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$ | 41.5 | 80             | 49.5           | M24×1.5                   | 25             | 0.8            | 44    | PT $\frac{1}{8}$ | 1.0               |  | 62 000                                    | 85 500          |
| 80              | 35 | 30 $\begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$ | 47.5 | 100            | 63             | M30×1.5                   | 32             | 1              | 51    | PT $\frac{1}{8}$ | 1.0               |  | 101 000                                   | 151 000         |
| 90              | 35 | 30 $\begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$ | 47.5 | 100            | 63             | M30×1.5                   | 32             | 1              | 51    | PT $\frac{1}{8}$ | 1.0               |  | 101 000                                   | 151 000         |
| 100             | 43 | 36 $\begin{smallmatrix} 0 \\ -0.025 \end{smallmatrix}$ | 48.5 | 120            | 74             | M36×1.5                   | 38             | 1.5            | 53    | PT $\frac{1}{8}$ | 1.5               |  | 119 000                                   | 167 000         |
| 120             | 50 | 42 $\begin{smallmatrix} 0 \\ -0.025 \end{smallmatrix}$ | 60.5 | 140            | 87             | M42×1.5                   | 44             | 1.5            | 66    | PT $\frac{1}{8}$ | 1.5               |  | 172 000                                   | 266 000         |
| 140             | 57 | 48 $\begin{smallmatrix} 0 \\ -0.025 \end{smallmatrix}$ | 65   | 160            | 100            | M48×1.5                   | 52             | 1.5            | 72.5  | PT $\frac{1}{8}$ | 2                 |  | 201 000                                   | 294 000         |
| 150             | 60 | 52 $\begin{smallmatrix} 0 \\ -0.030 \end{smallmatrix}$ | 75.5 | 170            | 107            | M52×1.5                   | 52             | 1.5            | 85.5  | PT $\frac{1}{8}$ | 2                 |  | 258 000                                   | 380 000         |
| 160             | 63 | 56 $\begin{smallmatrix} 0 \\ -0.030 \end{smallmatrix}$ | 80.5 | 180            | 113            | M56×3                     | 58             | 2              | 89.5  | PT $\frac{1}{8}$ | 2                 |  | 274 000                                   | 400 000         |
| 170             | 66 | 60 $\begin{smallmatrix} 0 \\ -0.030 \end{smallmatrix}$ | 86   | 190            | 120            | M60×3                     | 58             | 2              | 96.5  | PT $\frac{1}{8}$ | 2.5               |  | 320 000                                   | 475 000         |
| 180             | 72 | 64 $\begin{smallmatrix} 0 \\ -0.030 \end{smallmatrix}$ | 91.5 | 200            | 124            | M64×3                     | 65             | 2              | 103.5 | PT $\frac{1}{8}$ | 2.5               |  | 365 000                                   | 555 000         |

Note 1) The dimensional tolerance for the outer ring outer diameter  $D$  of Type NUKRU··X with cylindrical outer surface conforms to JIS Class-0.



## Accessories

| Nominal number of applied bearing | Nominal No. of grease nipple | Nominal No. of threaded plug with hexagon socket | Nominal No. of applied hexagon nut |
|-----------------------------------|------------------------------|--------------------------------------------------|------------------------------------|
| 30~35                             | JIS A-M6F                    | M6×0.75×6ℓ                                       | 1M12×1.5~1M16×1.5                  |
| 40~180                            | JIS A-PT $\frac{1}{8}$       | PT $\frac{1}{8}$ ×7ℓ                             | 1M18×1.5~1M64×3                    |

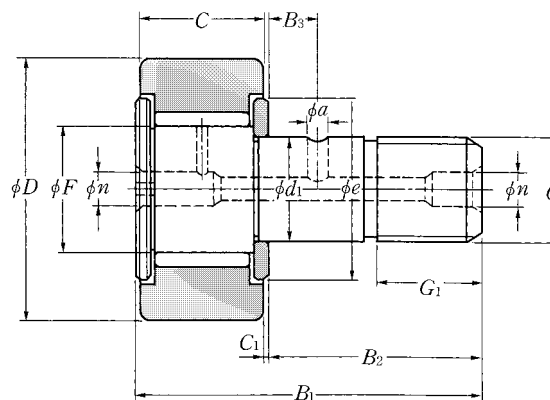
※Table 3 on B-179 and Table 5-2 on B-180 shows the respective boundary dimensions of grease nipple and threaded plug with hexagon socket.

| Basic load ratings |          | Load ratings of truck   |                           |                         |                           | Limiting<br>speeds<br>r/min<br>grease | Maximum<br>tightening torque |         | Bearing numbers           |                         | Mass      | Stud<br>diameter<br>mm |
|--------------------|----------|-------------------------|---------------------------|-------------------------|---------------------------|---------------------------------------|------------------------------|---------|---------------------------|-------------------------|-----------|------------------------|
| dynamic            | static   | N                       |                           | kgf                     |                           |                                       | N · m                        | kgf · m | Cylindrical<br>outer ring | Spherical<br>outer ring | kg        |                        |
| $C_r$              | $C_{or}$ | Spherical<br>outer ring | Cylindrical<br>outer ring | Spherical<br>outer ring | Cylindrical<br>outer ring |                                       |                              |         |                           |                         | (approx.) |                        |
| 1 360              | 1 380    | 2 620                   | 7 700                     | 267                     | 785                       | 6 900                                 | 20                           | 2       | NUKRU30                   | NUKRU30X                | 0.088     | 12                     |
| 2 280              | 2 620    | 3 200                   | 11 900                    | 325                     | 1 220                     | 5 500                                 | 52                           | 5.3     | NUKRU35                   | NUKRU35X                | 0.165     | 16                     |
| 2 450              | 2 970    | 3 850                   | 14 500                    | 390                     | 1 480                     | 4 700                                 | 76                           | 7.8     | NUKRU40                   | NUKRU40X                | 0.242     | 18                     |
| 3 950              | 4 900    | 4 700                   | 21 000                    | 480                     | 2 150                     | 4 000                                 | 98                           | 10      | NUKRU47                   | NUKRU47X                | 0.380     | 20                     |
| 4 350              | 5 850    | 5 550                   | 23 300                    | 565                     | 2 370                     | 3 300                                 | 98                           | 10      | NUKRU52                   | NUKRU52X                | 0.450     | 20                     |
| 5 750              | 7 400    | 6 950                   | 34 500                    | 710                     | 3 500                     | 2 900                                 | 178                          | 18      | NUKRU62                   | NUKRU62X                | 0.795     | 24                     |
| 6 350              | 8 700    | 8 050                   | 38 500                    | 820                     | 3 900                     | 2 400                                 | 178                          | 18      | NUKRU72                   | NUKRU72X                | 1.01      | 24                     |
| 10 300             | 15 400   | 9 800                   | 53 000                    | 1 000                   | 5 400                     | 2 100                                 | 360                          | 37      | NUKRU80                   | NUKRU80X                | 1.54      | 30                     |
| 10 300             | 15 400   | 11 400                  | 59 000                    | 1 160                   | 6 100                     | 2 100                                 | 360                          | 37      | NUKRU90                   | NUKRU90X                | 1.96      | 30                     |
| 12 100             | 17 000   | 13 000                  | 79 000                    | 1 300                   | 8 050                     | 2 000                                 | 630                          | 65      | NUKRU100                  | NUKRU100X               | 3.08      | 36                     |
| 17 600             | 27 100   | 16 400                  | 113 000                   | 1 670                   | 11 500                    | 1 700                                 | 1 020                        | 105     | NUKRU120                  | NUKRU120X               | 5.17      | 42                     |
| 20 500             | 30 000   | 20 000                  | 152 000                   | 2 040                   | 15 500                    | 1 500                                 | 1 540                        | 160     | NUKRU140                  | NUKRU140X               | 7.98      | 48                     |
| 26 300             | 39 000   | 22 000                  | 173 000                   | 2 250                   | 17 600                    | 1 300                                 | 1 950                        | 200     | NUKRU150                  | NUKRU150X               | 9.70      | 52                     |
| 27 900             | 41 000   | 24 000                  | 194 000                   | 2 450                   | 19 800                    | 1 200                                 | 2 480                        | 250     | NUKRU160                  | NUKRU160X               | 11.7      | 56                     |
| 32 500             | 48 500   | 26 000                  | 218 000                   | 2 650                   | 22 200                    | 1 100                                 | 3 030                        | 310     | NUKRU170                  | NUKRU170X               | 13.9      | 60                     |
| 37 500             | 56 500   | 27 900                  | 253 000                   | 2 840                   | 25 800                    | 1 000                                 | 3 670                        | 375     | NUKRU180                  | NUKRU180X               | 17.0      | 64                     |

## Inch series

Type CRV···X

Type CRV···XLL

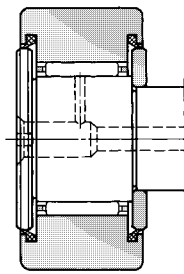
Type CR  
(with cage)

D 12.700~152.400mm

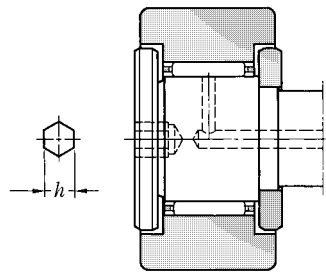
## Boundary dimensions

| D<br>0<br>-0.025         | C<br>0<br>-0.130          | d <sub>1</sub><br>+0.025<br>0 | F  | mm ( $\frac{1}{25.4}$ mm) |                | G                     | G <sub>1</sub> | C <sub>1</sub> | n               | B <sub>3</sub> | a | e    | h              |
|--------------------------|---------------------------|-------------------------------|----|---------------------------|----------------|-----------------------|----------------|----------------|-----------------|----------------|---|------|----------------|
|                          |                           |                               |    | B <sub>1</sub>            | B <sub>2</sub> |                       |                |                |                 |                |   |      |                |
| 12.700( $\frac{1}{2}$ )  | 8.731( $\frac{11}{32}$ )  | 4.762(-)                      | 6  | 23                        | 12.7           | NO-10-32UNF           | 6.4            | 0.8            | 3 <sup>2)</sup> | —              | — | 10   | $\frac{1}{8}$  |
|                          | 9.525( $\frac{3}{8}$ )    | 4.762(-)                      | 6  | 27                        | 15.9           | NO-10-32UNF           | 6.4            | 0.8            | 3 <sup>2)</sup> | —              | — | 10   | $\frac{1}{8}$  |
| 15.875( $\frac{5}{8}$ )  | 10.319( $\frac{13}{32}$ ) | 6.350( $\frac{1}{4}$ )        | 8  | 27.8                      | 15.9           | $\frac{1}{4}$ -28UNF  | 7.9            | 0.8            | 4 <sup>2)</sup> | —              | — | 12.5 | $\frac{1}{8}$  |
|                          | 11.112( $\frac{7}{16}$ )  | 6.350( $\frac{1}{4}$ )        | 8  | 31.8                      | 19.1           | $\frac{1}{4}$ -28UNF  | 7.9            | 0.8            | 4 <sup>2)</sup> | —              | — | 12.5 | $\frac{1}{8}$  |
| 19.050( $\frac{3}{4}$ )  | 12.700( $\frac{1}{2}$ )   | 9.525( $\frac{3}{8}$ )        | 12 | 36.5                      | 22.2           | $\frac{3}{8}$ -24UNF  | 9.5            | 0.8            | 4               | 6.35           | 3 | 16.2 | $\frac{3}{16}$ |
| 22.225( $\frac{7}{8}$ )  | 12.700( $\frac{1}{2}$ )   | 9.525( $\frac{3}{8}$ )        | 12 | 36.5                      | 22.2           | $\frac{3}{8}$ -24UNF  | 9.5            | 0.8            | 4               | 6.35           | 3 | 16.2 | $\frac{3}{16}$ |
| 25.400(1)                | 15.875( $\frac{5}{8}$ )   | 11.112( $\frac{7}{16}$ )      | 13 | 42.8                      | 25.4           | $\frac{7}{16}$ -20UNF | 12.7           | 0.8            | 4               | 6.35           | 3 | 21   | $\frac{1}{4}$  |
| 28.575(1 $\frac{1}{8}$ ) | 15.875( $\frac{5}{8}$ )   | 11.112( $\frac{7}{16}$ )      | 13 | 42.8                      | 25.4           | $\frac{7}{16}$ -20UNF | 12.7           | 0.8            | 4               | 6.35           | 3 | 21   | $\frac{1}{4}$  |
| 31.750(1 $\frac{1}{4}$ ) | 19.050( $\frac{3}{4}$ )   | 12.700( $\frac{1}{2}$ )       | 16 | 52.4                      | 31.8           | $\frac{1}{2}$ -20UNF  | 15.9           | 0.8            | 6               | 7.94           | 3 | 25   | $\frac{1}{4}$  |
| 34.925(1 $\frac{3}{8}$ ) | 19.050( $\frac{3}{4}$ )   | 12.700( $\frac{1}{2}$ )       | 16 | 52.4                      | 31.8           | $\frac{1}{2}$ -20UNF  | 15.9           | 0.8            | 6               | 7.94           | 3 | 25   | $\frac{1}{4}$  |
| 38.100(1 $\frac{1}{2}$ ) | 22.225( $\frac{7}{8}$ )   | 15.875( $\frac{5}{8}$ )       | 20 | 61.9                      | 38.1           | $\frac{5}{8}$ -18UNF  | 19.1           | 0.8            | 6               | 9.53           | 4 | 30   | $\frac{5}{16}$ |
| 41.275(1 $\frac{5}{8}$ ) | 22.225( $\frac{7}{8}$ )   | 15.875( $\frac{5}{8}$ )       | 20 | 61.9                      | 38.1           | $\frac{5}{8}$ -18UNF  | 19.1           | 0.8            | 6               | 9.53           | 4 | 30   | $\frac{5}{16}$ |
| 44.450(1 $\frac{3}{4}$ ) | 25.400(1)                 | 19.050( $\frac{3}{4}$ )       | 25 | 71.4                      | 44.4           | $\frac{3}{4}$ -16UNF  | 22.2           | 0.8            | 6               | 11.11          | 4 | 36.5 | $\frac{5}{16}$ |
| 47.625(1 $\frac{7}{8}$ ) | 25.400(1)                 | 19.050( $\frac{3}{4}$ )       | 25 | 71.4                      | 44.4           | $\frac{3}{4}$ -16UNF  | 22.2           | 0.8            | 6               | 11.11          | 4 | 36.5 | $\frac{5}{16}$ |
| 50.800(2)                | 31.750(1 $\frac{1}{4}$ )  | 22.225( $\frac{7}{8}$ )       | 30 | 84.1                      | 50.8           | $\frac{7}{8}$ -14UNF  | 25.4           | 0.8            | 8               | 12.7           | 5 | 41.5 | $\frac{7}{16}$ |
| 57.150(2 $\frac{1}{4}$ ) | 31.750(1 $\frac{1}{4}$ )  | 22.225( $\frac{7}{8}$ )       | 30 | 84.1                      | 50.8           | $\frac{7}{8}$ -14UNF  | 25.4           | 0.8            | 8               | 12.7           | 5 | 41.5 | $\frac{7}{16}$ |

1) For bearing with cylindrical outer surface, the nominal number is followed by "X" code. In this case, the cylindrical bearing is manufactured with the tolerance for outer ring outer diameter  $D$  which conforms to JIS Class-0. Ex. CR10XLL



**Type CR··LL**  
(with cage, sealed type)



**Type CR··H**  
(with hexagon hole)

| Basic load ratings   |                       |                      |                       | Load ratings of truck   |                           |                         |                           | Limiting speeds |         | Maximum tightening torque |       | Bearing numbers              |                                | Mass<br>(approx.)<br>kg<br><br>Type<br>CRV··X |
|----------------------|-----------------------|----------------------|-----------------------|-------------------------|---------------------------|-------------------------|---------------------------|-----------------|---------|---------------------------|-------|------------------------------|--------------------------------|-----------------------------------------------|
| dynamic              | static                | dynamic              | static                | N                       |                           | kgf                     |                           | r/min           |         | N·m                       | kgf·m | Type<br>CRV··X <sup>1)</sup> | Type<br>CRV··XLL <sup>1)</sup> |                                               |
| <i>C<sub>r</sub></i> | <i>C<sub>or</sub></i> | <i>C<sub>r</sub></i> | <i>C<sub>or</sub></i> | Spherical<br>outer ring | Cylindrical<br>outer ring | Spherical<br>outer ring | Cylindrical<br>outer ring | grease          | oil     |                           |       |                              |                                |                                               |
| 2 820                | 2 450                 | 287                  | 250                   | 2 090                   | 790                       | 213                     | 81                        | ※20 000         | ※28 000 | 2                         | 0.2   | CR8T2                        | ——                             | 0.009                                         |
| 2 820                | 2 450                 | 287                  | 250                   | 2 310                   | 790                       | 235                     | 81                        | ※20 000         | ※28 000 | 2                         | 0.2   | CR8-1T2                      | ——                             | 0.010                                         |
| 4 050                | 4 000                 | 415                  | 405                   | 3 000                   | 1 080                     | 310                     | 110                       | ※18 000         | ※25 000 | 4                         | 0.4   | CR10                         | ——                             | 0.020                                         |
| 4 050                | 4 000                 | 415                  | 405                   | 3 300                   | 1 080                     | 335                     | 110                       | ※18 000         | ※25 000 | 4                         | 0.4   | CR10-1                       | CR10-1LL                       | 0.022                                         |
| 5 300                | 6 650                 | 540                  | 680                   | 4 600                   | 1 380                     | 470                     | 140                       | 13 000          | ※16 000 | 13                        | 1.3   | CR12                         | CR12LL                         | 0.037                                         |
| 5 300                | 6 650                 | 540                  | 680                   | 5 350                   | 1 710                     | 545                     | 174                       | 13 000          | ※16 000 | 13                        | 1.3   | CR14                         | CR14LL                         | 0.048                                         |
| 7 250                | 8 350                 | 740                  | 850                   | 7 400                   | 2 060                     | 755                     | 210                       | 12 000          | 15 000  | 18                        | 1.9   | CR16                         | CR16LL                         | 0.087                                         |
| 7 250                | 8 350                 | 740                  | 850                   | 8 350                   | 2 430                     | 850                     | 248                       | 12 000          | 15 000  | 18                        | 1.9   | CR18                         | CR18LL                         | 0.100                                         |
| 11 400               | 15 900                | 1 160                | 1 620                 | 11 400                  | 2 840                     | 1 160                   | 290                       | 9 000           | 13 000  | 24                        | 2.4   | CR20                         | CR20LL                         | 0.150                                         |
| 11 400               | 15 900                | 1 160                | 1 620                 | 12 500                  | 3 250                     | 1 280                   | 330                       | 9 000           | 13 000  | 24                        | 2.4   | CR22                         | CR22LL                         | 0.166                                         |
| 13 300               | 20 100                | 1 360                | 2 120                 | 16 300                  | 3 600                     | 1 660                   | 365                       | 7 500           | 10 000  | 51                        | 5.2   | CR24                         | CR24LL                         | 0.235                                         |
| 13 300               | 20 100                | 1 360                | 2 120                 | 17 600                  | 4 050                     | 1 800                   | 410                       | 7 500           | 10 000  | 51                        | 5.2   | CR26                         | CR26LL                         | 0.265                                         |
| 20 700               | 33 500                | 2 110                | 3 450                 | 21 600                  | 4 400                     | 2 200                   | 450                       | 6 000           | 8 000   | 92                        | 9.3   | CR28                         | CR28LL                         | 0.375                                         |
| 20 700               | 33 500                | 2 110                | 3 450                 | 23 200                  | 4 850                     | 2 360                   | 495                       | 6 000           | 8 000   | 92                        | 9.3   | CR30                         | CR30LL                         | 0.420                                         |
| 28 900               | 55 000                | 2 950                | 5 600                 | 31 000                  | 5 300                     | 3 150                   | 540                       | 5 000           | 6 600   | 150                       | 15    | CR32                         | CR32LL                         | 0.505                                         |
| 28 900               | 55 000                | 2 950                | 5 600                 | 35 000                  | 6 200                     | 3 550                   | 635                       | 5 000           | 6 600   | 150                       | 15    | CR36                         | CR36LL                         | 0.750                                         |

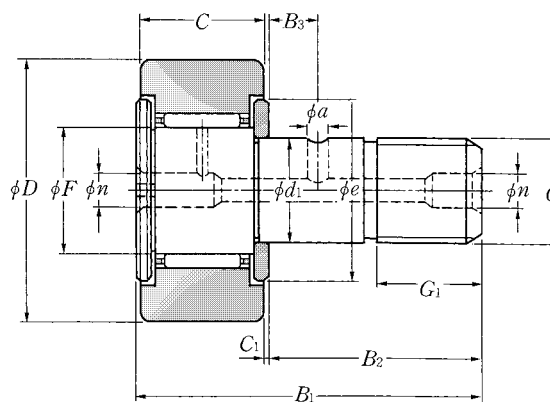
Note 2) Grease replenishing hole is provided at front side only (on left side-face in the above sketch). However, in the case with "hexagon hole" no grease replenishing hole is provided.

Remarks: For the cam follower with ※marked seal, the allowable running speed is approximately 10 000 r/min.

## Inch series

Type CRV···X

Type CRV···XLL

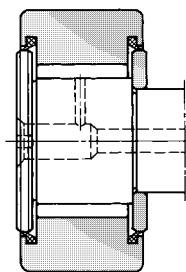
Type CRV···X  
(Full-complement roller type)

D 12.700~152.400mm

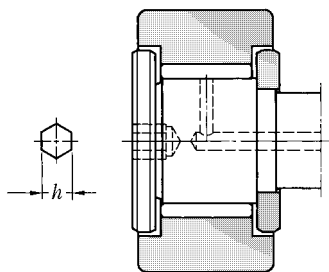
## Boundary dimensions

| D<br>0<br>-0.025 | C<br>0<br>-0.130 | d <sub>1</sub><br>+0.025<br>0 | F     | mm (1/25.4mm)  |                | G           | G <sub>1</sub> | C <sub>1</sub> | n               | B <sub>3</sub> | a | e    | h    |
|------------------|------------------|-------------------------------|-------|----------------|----------------|-------------|----------------|----------------|-----------------|----------------|---|------|------|
|                  |                  |                               |       | B <sub>1</sub> | B <sub>2</sub> |             |                |                |                 |                |   |      |      |
| 12.700(1/2)      | 8.731(11/32)     | 4.826(-)                      | 5.75  | 23             | 12.7           | NO-10-32UNF | 6.4            | 0.8            | 3 <sup>2)</sup> | -              | - | 10   | 1/8  |
|                  | 9.525(3/8)       | 4.826(-)                      | 5.75  | 27             | 15.9           | NO-10-32UNF | 6.4            | 0.8            | 3 <sup>2)</sup> | -              | - | 10   | 1/8  |
| 15.875(5/8)      | 10.319(13/32)    | 6.350(1/4)                    | 8.11  | 27.8           | 15.9           | 1/4-28UNF   | 7.9            | 0.8            | 4 <sup>2)</sup> | -              | - | 12.5 | 1/8  |
|                  | 11.112(7/16)     | 6.350(1/4)                    | 8.11  | 31.8           | 19.1           | 1/4-28UNF   | 7.9            | 0.8            | 4 <sup>2)</sup> | -              | - | 12.5 | 1/8  |
| 19.050(3/4)      | 12.700(1/2)      | 9.525(3/8)                    | 11    | 36.5           | 22.2           | 3/8-24UNF   | 9.5            | 0.8            | 4               | 6.35           | 3 | 15.5 | 3/16 |
| 22.225(7/8)      | 12.700(1/2)      | 9.525(3/8)                    | 11    | 36.5           | 22.2           | 3/8-24UNF   | 9.5            | 0.8            | 4               | 6.35           | 3 | 15.5 | 3/16 |
| 25.400(1)        | 15.875(5/8)      | 11.112(7/16)                  | 14    | 43             | 25.4           | 7/16-20UNF  | 12.7           | 0.8            | 4               | 6.35           | 3 | 19.5 | 1/4  |
| 28.575(1 1/8)    | 15.875(5/8)      | 11.112(7/16)                  | 14    | 43             | 25.4           | 7/16-20UNF  | 12.7           | 0.8            | 4               | 6.35           | 3 | 19.5 | 1/4  |
| 31.750(1 1/4)    | 19.050(3/4)      | 12.700(1/2)                   | 18.47 | 52.4           | 31.8           | 1/2-20UNF   | 15.9           | 0.8            | 6               | 7.94           | 3 | 25   | 1/4  |
| 34.925(1 3/8)    | 19.050(3/4)      | 12.700(1/2)                   | 18.47 | 52.4           | 31.8           | 1/2-20UNF   | 15.9           | 0.8            | 6               | 7.94           | 3 | 25   | 1/4  |
| 38.100(1 1/2)    | 22.225(7/8)      | 15.875(5/8)                   | 21    | 61.9           | 38.1           | 5/8-18UNF   | 19.1           | 0.8            | 6               | 9.53           | 4 | 27   | 5/16 |
| 41.275(1 5/8)    | 22.225(7/8)      | 15.875(5/8)                   | 21    | 61.9           | 38.1           | 5/8-18UNF   | 19.1           | 0.8            | 6               | 9.53           | 4 | 27   | 5/16 |
| 44.450(1 3/4)    | 25.400(1)        | 19.050(3/4)                   | 24.65 | 71.4           | 44.5           | 3/4-16UNF   | 22.2           | 0.8            | 6               | 11.11          | 4 | 36.5 | 5/16 |
| 47.625(1 7/8)    | 25.400(1)        | 19.050(3/4)                   | 24.65 | 71.4           | 44.5           | 3/4-16UNF   | 22.2           | 0.8            | 6               | 11.11          | 4 | 36.5 | 5/16 |
| 50.800(2)        | 31.750(1 1/4)    | 22.225(7/8)                   | 26.71 | 84.1           | 50.8           | 7/8-14UNF   | 25.4           | 0.8            | 6               | 12.7           | 5 | 36.5 | 7/16 |
| 57.150(2 1/4)    | 31.750(1 1/4)    | 22.225(7/8)                   | 26.71 | 84.1           | 50.8           | 7/8-14UNF   | 25.4           | 0.8            | 6               | 12.7           | 5 | 36.5 | 7/16 |
| 63.500(2 1/2)    | 38.100(1 1/2)    | 25.400(1)                     | 31.15 | 96.8           | 57.2           | 1-14UNF     | 28.6           | 0.8            | 6               | 14.29          | 5 | 44   | 1/2  |
| 69.850(2 3/4)    | 38.100(1 1/2)    | 25.400(1)                     | 31.15 | 96.8           | 57.2           | 1-14UNF     | 28.6           | 0.8            | 6               | 14.29          | 5 | 44   | 1/2  |
| 76.200(3)        | 44.450(1 3/4)    | 31.750(1 1/4)                 | 36.85 | 109.5          | 63.5           | 1 1/4-12UNF | 31.8           | 0.8            | 8               | 15.88          | 5 | 53   | 5/8  |
| 82.550(3 1/4)    | 44.450(1 3/4)    | 31.750(1 1/4)                 | 36.85 | 109.5          | 63.5           | 1 1/4-12UNF | 31.8           | 0.8            | 8               | 15.88          | 5 | 53   | 5/8  |
| 88.900(3 1/2)    | 50.800(2)        | 34.925(1 3/8)                 | 44.5  | 122.2          | 69.9           | 1 3/8-12UNF | 34.9           | 0.8            | 8               | 17.46          | 5 | 60   | 5/8  |
| 101.600(4)       | 57.150(2 1/4)    | 38.100(1 1/2)                 | 44.5  | 147.6          | 88.9           | 1 1/2-12UNF | 38.1           | 0.8            | 8               | 19.05          | 5 | 63   | 3/4  |
| 127.000(5)       | 69.850(2 3/4)    | 50.800(2)                     | 68.7  | 200            | 128.6          | 2-12UNF     | 65.1           | 0.8            | 8               | 22.23          | 5 | 89   | 7/8  |
| 152.400(6)       | 82.550(3 1/4)    | 63.500(2 1/2)                 | 81.35 | 236.6          | 152.4          | 2 1/2-12UNF | 76.2           | 0.8            | 8               | 25.4           | 5 | 110  | 1    |

Note 1) For bearing with spherical outer surface, the nominal number is followed by "X" code. In this case, the spherical bearing (R=500) is manufactured with the tolerance 0,-0.05 for the outer ring outer diameter D.



**Type CRV··XLL**  
(Full-complement roller and sealed type)



**Type CRV··H**  
(with hexagon hole)

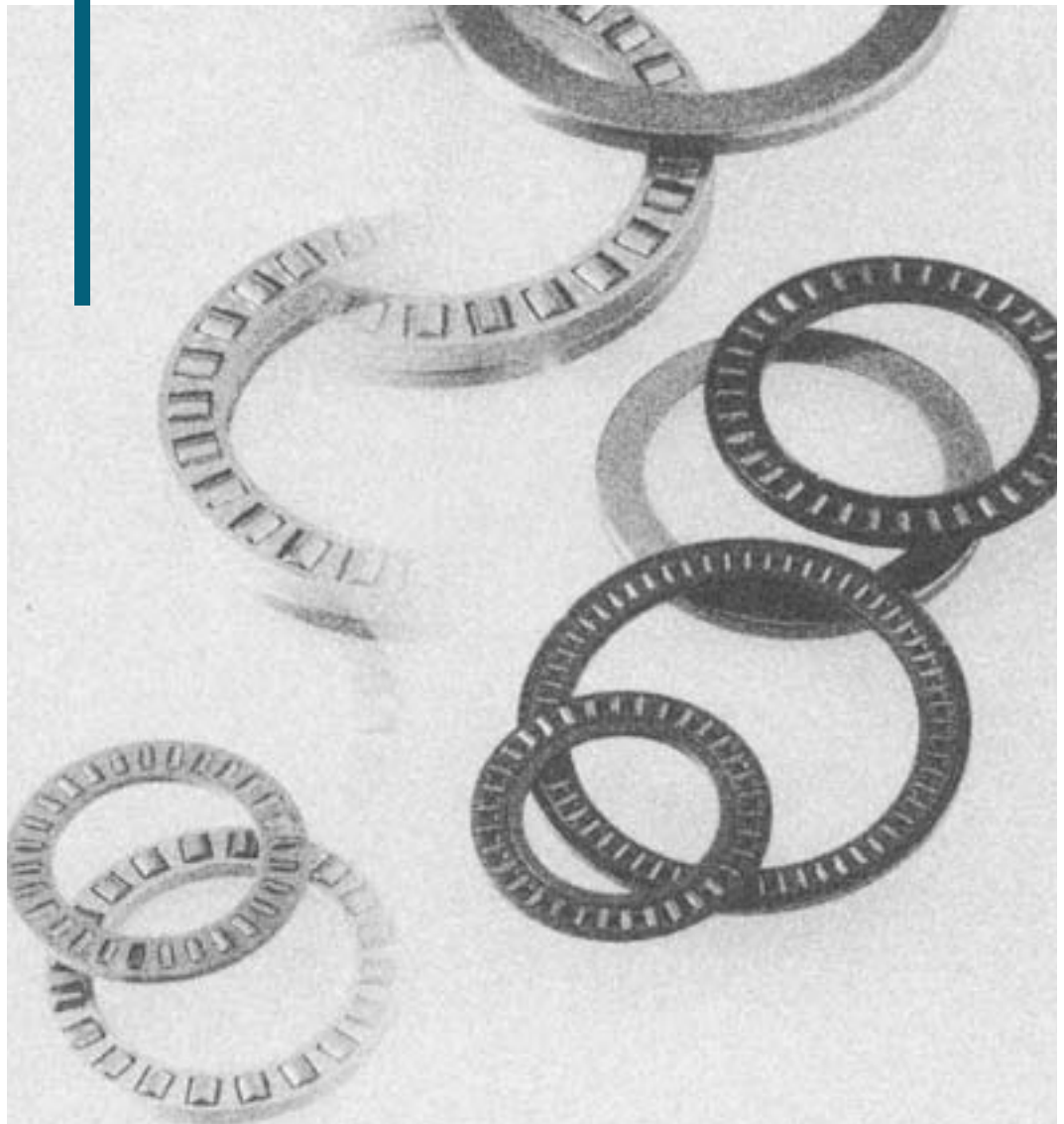
| Basic load ratings |          |         |          | Load ratings of truck   |                           |                         |                           | Limiting speeds |         | Maximum tightening torque |     | Bearing numbers      |                        | Mass (approx.)<br>kg<br>Type CRV··X |
|--------------------|----------|---------|----------|-------------------------|---------------------------|-------------------------|---------------------------|-----------------|---------|---------------------------|-----|----------------------|------------------------|-------------------------------------|
| dynamic            | static   | dynamic | static   | N                       |                           | kgf                     |                           | r/min           |         | N·m   kgf·m               |     | Type                 | Type                   |                                     |
| $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ | Spherical<br>outer ring | Cylindrical<br>outer ring | Spherical<br>outer ring | Cylindrical<br>outer ring | grease          | oil     |                           |     | CRV··X <sup>1)</sup> | CRV··XLL <sup>1)</sup> |                                     |
| 3 400              | 3 750    | 350     | 385      | 2 090                   | 790                       | 213                     | 81                        | ※17 000         | ※22 000 | 2                         | 0.2 | CRV8X                | CRV8XLL                | 0.010                               |
| 3 950              | 4 550    | 405     | 465      | 2 310                   | 790                       | 235                     | 81                        | ※17 000         | ※22 000 | 2                         | 0.2 | CRV8-1X              | CRV8-1XLL              | 0.011                               |
| 5 550              | 7 600    | 565     | 770      | 3 000                   | 1 080                     | 310                     | 110                       | ※12 000         | ※15 000 | 4                         | 0.4 | CRV10X               | CRV10XLL               | 0.020                               |
| 6 200              | 8 700    | 630     | 885      | 3 300                   | 1 080                     | 335                     | 110                       | ※12 000         | ※15 000 | 4                         | 0.4 | CRV10-1X             | CRV10-1XLL             | 0.022                               |
| 8 050              | 13 300   | 825     | 1 360    | 4 600                   | 1 380                     | 470                     | 140                       | 9 000           | ※11 000 | 13                        | 1.3 | CRV12X               | CRV12XLL               | 0.038                               |
| 8 050              | 13 300   | 825     | 1 360    | 5 350                   | 1 710                     | 545                     | 174                       | 9 000           | ※11 000 | 13                        | 1.3 | CRV14X               | CRV14XLL               | 0.048                               |
| 11 700             | 18 900   | 1 190   | 1 920    | 7 400                   | 2 060                     | 755                     | 210                       | 7 100           | 9 200   | 18                        | 1.9 | CRV16X               | CRV16XLL               | 0.080                               |
| 11 700             | 18 900   | 1 190   | 1 920    | 8 350                   | 2 430                     | 850                     | 248                       | 7 100           | 9 200   | 18                        | 1.9 | CRV18X               | CRV18XLL               | 0.096                               |
| 17 700             | 35 000   | 1 810   | 3 600    | 11 400                  | 2 840                     | 1 160                   | 290                       | 5 400           | 7 000   | 24                        | 2.4 | CRV20X               | CRV20XLL               | 0.140                               |
| 17 700             | 35 000   | 1 810   | 3 600    | 12 500                  | 3 250                     | 1 280                   | 330                       | 5 400           | 7 000   | 24                        | 2.4 | CRV22X               | CRV22XLL               | 0.165                               |
| 21 100             | 45 500   | 2 150   | 4 650    | 16 300                  | 3 600                     | 1 660                   | 365                       | 4 800           | 6 200   | 51                        | 5.2 | CRV24X               | CRV24XLL               | 0.240                               |
| 21 100             | 45 500   | 2 150   | 4 650    | 17 600                  | 4 050                     | 1 800                   | 410                       | 4 800           | 6 200   | 51                        | 5.2 | CRV26X               | CRV26XLL               | 0.280                               |
| 28 400             | 60 500   | 2 900   | 6 150    | 21 600                  | 4 400                     | 2 200                   | 450                       | 4 100           | 5 300   | 92                        | 9.3 | CRV28X               | CRV28XLL               | 0.400                               |
| 28 400             | 60 500   | 2 900   | 6 150    | 23 200                  | 4 850                     | 2 360                   | 495                       | 4 100           | 5 300   | 92                        | 9.3 | CRV30X               | CRV30XLL               | 0.440                               |
| 41 000             | 87 500   | 4 200   | 8 950    | 31 000                  | 5 300                     | 3 150                   | 540                       | 3 700           | 4 800   | 150                       | 15  | CRV32X               | CRV32XLL               | 0.650                               |
| 41 000             | 87 500   | 4 200   | 8 950    | 35 000                  | 6 200                     | 3 550                   | 635                       | 3 700           | 4 800   | 150                       | 15  | CRV36X               | CRV36XLL               | 0.780                               |
| 54 500             | 119 000  | 5 600   | 12 200   | 44 500                  | 7 200                     | 4 550                   | 735                       | 3 200           | 4 100   | 230                       | 23  | CRV40X               | CRV40XLL               | 1.20                                |
| 54 500             | 119 000  | 5 600   | 12 200   | 49 000                  | 8 250                     | 5 000                   | 840                       | 3 200           | 4 100   | 230                       | 23  | CRV44X               | CRV44XLL               | 1.34                                |
| 76 500             | 177 000  | 7 800   | 18 000   | 64 000                  | 9 150                     | 6 500                   | 935                       | 2 700           | 3 500   | 435                       | 45  | CRV48X               | CRV48XLL               | 1.92                                |
| 76 500             | 177 000  | 7 800   | 18 000   | 69 000                  | 10 000                    | 7 050                   | 1 020                     | 2 700           | 3 500   | 435                       | 45  | CRV52X               | CRV52XLL               | 2.20                                |
| 84 500             | 214 000  | 8 650   | 21 800   | 86 500                  | 11 100                    | 8 800                   | 1 130                     | 2 200           | 2 800   | 580                       | 60  | CRV56X               | CRV56XLL               | 2.92                                |
| 106 000            | 244 000  | 10 800  | 24 900   | 113 000                 | 13 200                    | 11 500                  | 1 350                     | 2 200           | 2 800   | 760                       | 78  | CRV64X               | CRV64XLL               | 4.32                                |
| 189 000            | 520 000  | 19 300  | 53 000   | 165 000                 | 17 900                    | 16 900                  | 1 830                     | 1 500           | 1 900   | 1 820                     | 190 | CRV80X               | CRV80XLL               | 8.80                                |
| 260 000            | 675 000  | 26 500  | 68 500   | 240 000                 | 22 100                    | 24 400                  | 2 250                     | 1 200           | 1 500   | 3 550                     | 360 | CRV96X               | CRV96XLL               | 15.3                                |

Note 2) Grease replenishing hole is provided at front side only (on left side-face in the above sketch). However, in the case with "hexagon hole" no grease replenishing hole is provided.

Remarks: For the cam follower with ※marked seal, the allowable running speed is approximately 10 000 r/min.



# Thrust Roller Bearings



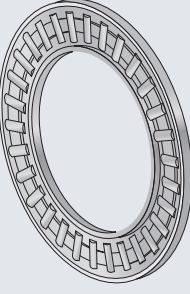
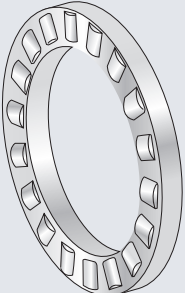
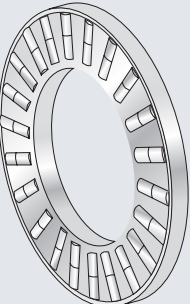
## Thrust Roller Bearings

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.

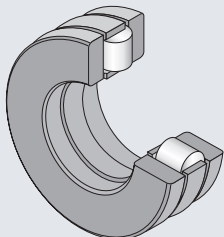
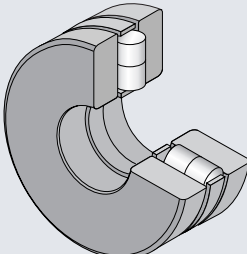
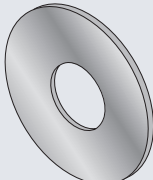
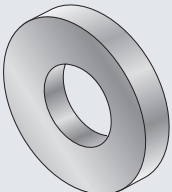
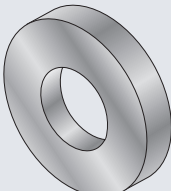
In mounting, it is possible to use a shaft or a housing as the direct raceway surface without using the bearing

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                          | Applied shaft dia (mm)                                                        | Composition of nominal number                                                               | Nominal number  | Remarks                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------------------------------------------------------------------------------|------------------------------------|-------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>AXK</b><br>         | Punched steel plate cage           | $\phi 10 \sim \phi 120$                                                       | <b>AXK 11 04</b><br>Bore diameter code<br>Dimension series code<br>Type code                | <b>AXK1104</b>  | Possible to use in combination with AS type bearing ring.                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                                                                                                         | High tensile brass cage            | $\phi 130 \sim \phi 160$                                                      |                                                                                             |                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>K811 K812</b><br> | Standard type Polyamide resin cage | Type K811<br>$\phi 10 \sim \phi 120$<br>Type K812<br>$\phi 30 \sim \phi 80$   | <b>K8 11 10 T2</b><br>Tail code<br>Bore diameter code<br>Dimension series code<br>Type code | <b>K81110T2</b> | Any bearing type with tail code T2, that is, with polyamide resin cage shall be used at allowable temperature 120°C and, under continuous running, at 100°C and less.<br><br>Feel free to contact <b>NTN</b> for the detail of the punched steel plate cage.<br><br>Possible to use in combination with GS and WS bearing rings.<br><br>K811 conforms to the Dimension Series 11 specified in JIS B 1512.<br><br>K812 conforms to the Dimension Series 12 specified in JIS B 1512. |
|                                                                                                         | Aluminum alloy cage                | Type K811<br>$\phi 130 \sim \phi 160$<br>Type K812<br>$\phi 85 \sim \phi 140$ |                                                                                             |                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|                                                                                                         | Punched steel plate cage           | $\phi 10 \sim \phi 90$                                                        | <b>[Tail code]</b><br>T2: resin cage<br>JW: Punched steel plate cage                        |                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>K893</b><br>      | Aluminum alloy cage                | $\phi 30 \sim \phi 110$                                                       | <b>K8 93 10</b><br>Bore diameter code<br>Dimension series code<br>Type code                 | <b>K89310</b>   | K893 conforms to the Dimension Series 93 specified in JIS B 1512.                                                                                                                                                                                                                                                                                                                                                                                                                  |



| Bearing type   |                                                                                     | Applied shaft dia (mm)   | Composition of nominal number                                                                                                                                                                                          | Nominal number                                                                                           | Remarks                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                 |
|----------------|-------------------------------------------------------------------------------------|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 811<br>812     |    | $\phi 10 \sim \phi 160$  | <div>8 11 10 T2</div> <div>Tail code</div> <div>Bore diameter code</div> <div>Dimension series code</div> <div>Type code</div> <div>[Tail code]</div> <div>T2: resin cage</div> <div>J: Punched steel plate cage</div> | 81110T2                                                                                                  | <p>Any bearing type with tail code T2, that is, with polyamide resin cage shall be used at allowable temperature 120°C and, under continuous running, at 100°C and less.</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> |                                                                                                                                                                                                                                                                                                                                                 |
| 893            |   | $\phi 30 \sim \phi 110$  | <div>8 93 10</div> <div>Bore diameter code</div> <div>Dimension series code</div> <div>Type code</div>                                                                                                                 | 89310                                                                                                    | <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>                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                 |
| AS             |  | Punched steel plate cage | $\phi 10 \sim \phi 130$                                                                                                                                                                                                | <div>AS 11 04</div> <div>Bore diameter code</div> <div>Dimension series code</div> <div>Type code</div>  | AS1104                                                                                                                                                                                                                                                                                                                                                                       | <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> |
| WS811<br>WS812 |   | Solid type bore guide    | $\phi 10 \sim \phi 160$                                                                                                                                                                                                | <div>WS8 11 04</div> <div>Bore diameter code</div> <div>Dimension series code</div> <div>Type code</div> | WS81104                                                                                                                                                                                                                                                                                                                                                                      | <p>Higher rigidity and higher running accuracy than AS bearing ring .</p>                                                                                                                                                                                                                                                                       |
| GS811<br>GS812 |   | Solid type outer guide   | $\phi 10 \sim \phi 160$                                                                                                                                                                                                | <div>GS8 11 04</div> <div>Bore diameter code</div> <div>Dimension series code</div> <div>Type code</div> | GS81104                                                                                                                                                                                                                                                                                                                                                                      | <p>Higher rigidity and higher running accuracy than AS bearing ring .</p>                                                                                                                                                                                                                                                                       |

### Bearing accuracy

The respective dimensional accuracy, profile accuracy and running accuracy of thrust cylindrical roller bearings 811, 812 and 893 are as shown in **Table 4.4** of Section 4 "Bearing Accuracy" (page A-28).

The thrust roller and cage assemblies (**AXK**, **K811**, **K812**, **K893**) are machined with dimensional tolerance E11 for the bore diameter ( $D_{e1}$ ) (E12 for bearing number with T2 code) and with dimensional tolerance c12 for the outer diameter ( $D_e$ ) of **Type AXK** and a13 for the diameter ( $D_e$ ) of **K811**, **K812** and **K893**.

### 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**

| Characteristics                | Specified requirements               |
|--------------------------------|--------------------------------------|
| Perpendicularity (Max)         | IT6 (IT4)                            |
| Surface roughness              | 0.2a                                 |
| Surface hardness               | HRC58~64                             |
| Effective hardened layer depth | Refer to Formula (7.1) on page A-39. |

Reference : The parenthesized value shall be applied for high running accuracy.

### Cage guiding

The thrust roller and cage assemblies (**AXK**, **K811**, **K812** and **K893**) must be guided at either the bore side (shaft side) or the outer surface side (housing side) for in-running centering.

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**

| Bearing ring | Shaft | Housing |
|--------------|-------|---------|
| Series AS    | h10   | H11     |
| Series WS    | h6    | —       |
| Series GS    | —     | H7      |

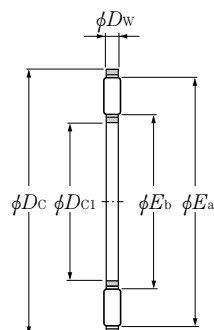
### Mounting related dimensions

The dimensions related to fitting of **WS** and **GS** bearing rings on shaft and in housing are as described in applicable Dimensions Table.

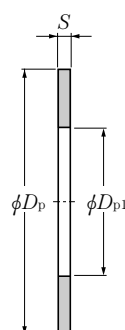
The fitting surface of **AS** bearing ring must be flat and have the rigidity sufficient to support thrust load throughout its entire surface.



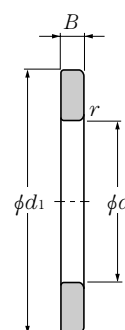
Type AXK11  
Type AS11  
Type WS811  
Type GS811



**Type AXK**  
(Thrust needle roller  
and cage assy)



**AS bearing ring**  
(washer)



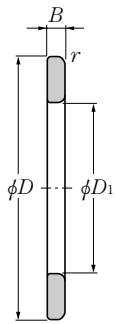
**WS bearing ring**  
(Inner ring)

$D_{c1}$  10~140mm

| Boundary dimensions |       |                                                    |       |          |          |     |       |     |                                                      |                                                          |                   | Basic load ratings |          |         |          |
|---------------------|-------|----------------------------------------------------|-------|----------|----------|-----|-------|-----|------------------------------------------------------|----------------------------------------------------------|-------------------|--------------------|----------|---------|----------|
| $D_{c1}$            | $D_c$ | $D_w$                                              | $D_p$ | $D_{p1}$ | $S^{2)}$ | mm  |       | $D$ | $D_1$                                                | $B$                                                      | $r_{s\ min}^{1)}$ | dynamic            | static   | dynamic | static   |
| E11                 | c12   | $\begin{smallmatrix} 0 \\ -0.01 \end{smallmatrix}$ | e13   | E12      | 0.05     | $d$ | $d_1$ |     | $\begin{smallmatrix} +0.5 \\ +0.2 \end{smallmatrix}$ |                                                          |                   | $C_a$              | $C_{oa}$ | $C_a$   | $C_{oa}$ |
| 10                  | 24    | 2                                                  | 24    | 10       | 1        | 10  | 24    | 24  | 10                                                   | $2.75 \begin{smallmatrix} 0 \\ -0.060 \end{smallmatrix}$ | 0.3               | 9 150              | 25 300   | 935     | 2 580    |
| 12                  | 26    | 2                                                  | 26    | 12       | 1        | 12  | 26    | 26  | 12                                                   | $2.75 \begin{smallmatrix} 0 \\ -0.060 \end{smallmatrix}$ | 0.3               | 9 850              | 28 900   | 1 010   | 2 940    |
| 15                  | 28    | 2                                                  | 28    | 15       | 1        | 15  | 28    | 28  | 16                                                   | $2.75 \begin{smallmatrix} 0 \\ -0.060 \end{smallmatrix}$ | 0.3               | 11 300             | 36 000   | 1 150   | 3 700    |
| 17                  | 30    | 2                                                  | 30    | 17       | 1        | 17  | 30    | 30  | 18                                                   | $2.75 \begin{smallmatrix} 0 \\ -0.060 \end{smallmatrix}$ | 0.3               | 11 900             | 39 500   | 1 220   | 4 050    |
| 20                  | 35    | 2                                                  | 35    | 20       | 1        | 20  | 35    | 35  | 21                                                   | $2.75 \begin{smallmatrix} 0 \\ -0.060 \end{smallmatrix}$ | 0.3               | 13 200             | 46 500   | 1 340   | 4 750    |
| 25                  | 42    | 2                                                  | 42    | 25       | 1        | 25  | 42    | 42  | 26                                                   | $3 \begin{smallmatrix} 0 \\ -0.060 \end{smallmatrix}$    | 0.6               | 14 600             | 58 000   | 1 490   | 5 900    |
| 30                  | 47    | 2                                                  | 47    | 30       | 1        | 30  | 47    | 47  | 32                                                   | $3 \begin{smallmatrix} 0 \\ -0.060 \end{smallmatrix}$    | 0.6               | 16 300             | 69 500   | 1 660   | 7 100    |
| 35                  | 52    | 2                                                  | 52    | 35       | 1        | 35  | 52    | 52  | 37                                                   | $3.5 \begin{smallmatrix} 0 \\ -0.075 \end{smallmatrix}$  | 0.6               | 17 800             | 81 500   | 1 820   | 8 300    |
| 40                  | 60    | 3                                                  | 60    | 40       | 1        | 40  | 60    | 60  | 42                                                   | $3.5 \begin{smallmatrix} 0 \\ -0.075 \end{smallmatrix}$  | 0.6               | 27 400             | 110 000  | 2 790   | 11 300   |
| 45                  | 65    | 3                                                  | 65    | 45       | 1        | 45  | 65    | 65  | 47                                                   | $4 \begin{smallmatrix} 0 \\ -0.075 \end{smallmatrix}$    | 0.6               | 29 800             | 128 000  | 3 050   | 13 100   |
| 50                  | 70    | 3                                                  | 70    | 50       | 1        | 50  | 70    | 70  | 52                                                   | $4 \begin{smallmatrix} 0 \\ -0.075 \end{smallmatrix}$    | 0.6               | 31 500             | 143 000  | 3 250   | 14 500   |
| 55                  | 78    | 3                                                  | 78    | 55       | 1        | 55  | 78    | 78  | 57                                                   | $5 \begin{smallmatrix} 0 \\ -0.075 \end{smallmatrix}$    | 0.6               | 38 000             | 186 000  | 3 850   | 19 000   |
| 60                  | 85    | 3                                                  | 85    | 60       | 1        | 60  | 85    | 85  | 62                                                   | $4.75 \begin{smallmatrix} 0 \\ -0.075 \end{smallmatrix}$ | 1                 | 44 500             | 234 000  | 4 550   | 23 900   |
| 65                  | 90    | 3                                                  | 90    | 65       | 1        | 65  | 90    | 90  | 67                                                   | $5.25 \begin{smallmatrix} 0 \\ -0.075 \end{smallmatrix}$ | 1                 | 46 500             | 254 000  | 4 750   | 25 900   |
| 70                  | 95    | 4                                                  | 95    | 70       | 1        | 70  | 95    | 95  | 72                                                   | $5.25 \begin{smallmatrix} 0 \\ -0.075 \end{smallmatrix}$ | 1                 | 53 500             | 253 000  | 5 500   | 25 800   |
| 75                  | 100   | 4                                                  | 100   | 75       | 1        | 75  | 100   | 100 | 77                                                   | $5.75 \begin{smallmatrix} 0 \\ -0.075 \end{smallmatrix}$ | 1                 | 55 000             | 266 000  | 5 650   | 27 100   |
| 80                  | 105   | 4                                                  | 105   | 80       | 1        | 80  | 105   | 105 | 82                                                   | $5.75 \begin{smallmatrix} 0 \\ -0.075 \end{smallmatrix}$ | 1                 | 56 500             | 279 000  | 5 750   | 28 400   |
| 85                  | 110   | 4                                                  | 110   | 85       | 1        | 85  | 110   | 110 | 87                                                   | $5.75 \begin{smallmatrix} 0 \\ -0.075 \end{smallmatrix}$ | 1                 | 57 500             | 291 000  | 5 900   | 29 700   |
| 90                  | 120   | 4                                                  | 120   | 90       | 1        | 90  | 120   | 120 | 92                                                   | $6.5 \begin{smallmatrix} 0 \\ -0.090 \end{smallmatrix}$  | 1                 | 71 000             | 390 000  | 7 250   | 39 500   |
| 100                 | 135   | 4                                                  | 135   | 100      | 1        | 100 | 135   | 135 | 102                                                  | $7 \begin{smallmatrix} 0 \\ -0.090 \end{smallmatrix}$    | 1                 | 90 500             | 550 000  | 9 200   | 56 500   |
| 110                 | 145   | 4                                                  | 145   | 110      | 1        | 110 | 145   | 145 | 112                                                  | $7 \begin{smallmatrix} 0 \\ -0.090 \end{smallmatrix}$    | 1                 | 93 500             | 590 000  | 9 550   | 60 500   |
| 120                 | 155   | 4                                                  | 155   | 120      | 1        | 120 | 155   | 155 | 122                                                  | $7 \begin{smallmatrix} 0 \\ -0.090 \end{smallmatrix}$    | 1                 | 99 000             | 650 000  | 10 100  | 66 500   |
| 130                 | 170   | 5                                                  | 170   | 130      | 1        | 130 | 170   | 170 | 132                                                  | $9 \begin{smallmatrix} 0 \\ -0.090 \end{smallmatrix}$    | 1                 | 140 000            | 900 000  | 14 300  | 92 000   |
| 140                 | 180   | 5                                                  | 180   | 140      | 1        | 140 | 178   | 180 | 142                                                  | $9.5 \begin{smallmatrix} 0 \\ -0.090 \end{smallmatrix}$  | 1                 | 145 000            | 960 000  | 14 800  | 97 500   |

Note 1) Allowable minimum chamfer dimension  $r_s$ .

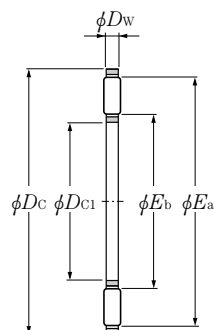
2) Subject to measured thrust load of 20kg or more.



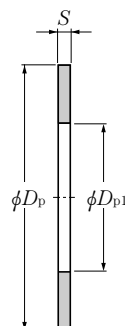
**GS bearing ring  
(Outer ring)**

| Limiting speeds |        | Bearing numbers                        |        |            |            | Reference dimensions |       | Mass         |        |                |
|-----------------|--------|----------------------------------------|--------|------------|------------|----------------------|-------|--------------|--------|----------------|
| grease          | oil    | thrust needle roller and cage assembly | washer | inner ring | outer ring | mm                   |       | kg (approx.) |        |                |
|                 |        |                                        |        |            |            | $E_b$                | $E_a$ | AXK11        | AS11   | WS811<br>GS811 |
| 3 500           | 14 000 | AXK1100                                | AS1100 | WS81100    | GS81100    | 12.3                 | 21.7  | 0.0028       | 0.003  | 0.008          |
| 3 300           | 13 000 | AXK1101                                | AS1101 | WS81101    | GS81101    | 14.3                 | 23.7  | 0.003        | 0.0033 | 0.009          |
| 2 800           | 11 000 | AXK1102                                | AS1102 | WS81102    | GS81102    | 17.2                 | 26.5  | 0.0035       | 0.0035 | 0.01           |
| 2 500           | 10 000 | AXK1103                                | AS1103 | WS81103    | GS81103    | 19.2                 | 28.5  | 0.004        | 0.0038 | 0.011          |
| 2 100           | 8 500  | AXK1104                                | AS1104 | WS81104    | GS81104    | 21.3                 | 31.3  | 0.005        | 0.0051 | 0.014          |
| 1 800           | 7 000  | AXK1105                                | AS1105 | WS81105    | GS81105    | 29.5                 | 39.4  | 0.007        | 0.007  | 0.021          |
| 1 500           | 6 000  | AXK1106                                | AS1106 | WS81106    | GS81106    | 34.5                 | 44.4  | 0.008        | 0.008  | 0.025          |
| 1 400           | 5 500  | AXK1107                                | AS1107 | WS81107    | GS81107    | 39.5                 | 49.4  | 0.01         | 0.0091 | 0.033          |
| 1 200           | 4 700  | AXK1108                                | AS1108 | WS81108    | GS81108    | 44.2                 | 56.2  | 0.0185       | 0.0123 | 0.044          |
| 1 100           | 4 300  | AXK1109                                | AS1109 | WS81109    | GS81109    | 50.5                 | 62.4  | 0.0205       | 0.0136 | 0.055          |
| 1 000           | 3 900  | AXK1110                                | AS1110 | WS81110    | GS81110    | 55.5                 | 67.4  | 0.0235       | 0.0148 | 0.06           |
| 900             | 3 500  | AXK1111                                | AS1111 | WS81111    | GS81111    | 61.0                 | 74.9  | 0.0308       | 0.0189 | 0.095          |
| 800             | 3 200  | AXK1112                                | AS1112 | WS81112    | GS81112    | 66.0                 | 81.9  | 0.0390       | 0.0223 | 0.101          |
| 750             | 3 000  | AXK1113                                | AS1113 | WS81113    | GS81113    | 71.0                 | 86.9  | 0.04         | 0.0239 | 0.125          |
| 750             | 2 900  | AXK1114                                | AS1114 | WS81114    | GS81114    | 75.5                 | 91.4  | 0.06         | 0.0254 | 0.134          |
| 700             | 2 700  | AXK1115                                | AS1115 | WS81115    | GS81115    | 80.5                 | 96.4  | 0.061        | 0.027  | 0.155          |
| 650             | 2 600  | AXK1116                                | AS1116 | WS81116    | GS81116    | 84.4                 | 100.3 | 0.063        | 0.0284 | 0.163          |
| 600             | 2 400  | AXK1117                                | AS1117 | WS81117    | GS81117    | 90.5                 | 106.4 | 0.0668       | 0.0301 | 0.175          |
| 600             | 2 300  | AXK1118                                | AS1118 | WS81118    | GS81118    | 96.5                 | 116.4 | 0.086        | 0.0388 | 0.25           |
| 500             | 2 000  | AXK1120                                | AS1120 | WS81120    | GS81120    | 107.5                | 131.4 | 0.112        | 0.0505 | 0.35           |
| 480             | 1 900  | AXK1122                                | AS1122 | WS81122    | GS81122    | 115.5                | 139.4 | 0.122        | 0.0549 | 0.385          |
| 430             | 1 700  | AXK1124                                | AS1124 | WS81124    | GS81124    | 125.5                | 149.4 | 0.131        | 0.0592 | 0.415          |
| 400             | 1 600  | AXK1126                                | AS1126 | WS81126    | GS81126    | 136.0                | 164.0 | 0.205        | 0.074  | 0.663          |
| 380             | 1 500  | AXK1128                                | AS1128 | WS81128    | GS81128    | 146.0                | 174.0 | 0.219        | 0.079  | 0.749          |

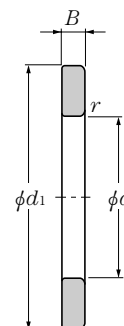
Type AXK11  
Type AS11  
Type WS811  
Type GS811



**Type AXK**  
(Thrust needle roller  
and cage assy)



**AS bearing ring**  
(washer)

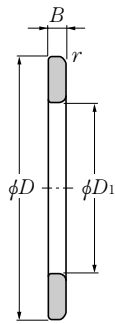


**WS bearing ring**  
(inner ring)

$D_{c1}$  150~160mm

| Boundary dimensions |       |                                                    |       |          |          |     |       |     |                                                      |                                                     |                 | Basic load ratings |           |         |          |
|---------------------|-------|----------------------------------------------------|-------|----------|----------|-----|-------|-----|------------------------------------------------------|-----------------------------------------------------|-----------------|--------------------|-----------|---------|----------|
| $D_{c1}$            | $D_c$ | $D_w$                                              | $D_p$ | $D_{p1}$ | $S^{2)}$ | mm  |       | $D$ | $D_1$                                                | $B$                                                 | $r_{s\ min}^1)$ | dynamic            | static    | dynamic | static   |
| E11                 | c12   | $\begin{smallmatrix} 0 \\ -0.01 \end{smallmatrix}$ | e13   | E12      | 0.05     | $d$ | $d_1$ |     | $\begin{smallmatrix} +0.5 \\ +0.2 \end{smallmatrix}$ |                                                     |                 | $C_a$              | $C_{oa}$  | $C_a$   | $C_{oa}$ |
| 150                 | 190   | 5                                                  | 190   | 150      | 1        | 150 | 188   | 190 | 152                                                  | $\begin{smallmatrix} 0 \\ -0.090 \end{smallmatrix}$ | 1               | 149 000            | 1 020 000 | 15 200  | 104 000  |
| 160                 | 200   | 5                                                  | 200   | 160      | 1        | 160 | 198   | 200 | 162                                                  | $\begin{smallmatrix} 0 \\ -0.090 \end{smallmatrix}$ | 1               | 154 000            | 1 070 000 | 15 700  | 110 000  |

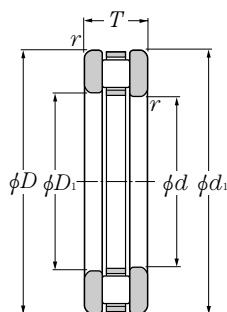
Note 1) Allowable minimum chamfer dimension  $r$ .  
2) Subject to measured thrust load of 20kg or more.



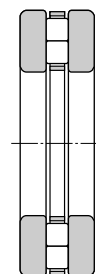
**GS bearing ring**  
(Outer ring)

| Limiting speeds |       | Bearing numbers                        |               |                |                | Reference dimensions |       | Mass         |       |                |
|-----------------|-------|----------------------------------------|---------------|----------------|----------------|----------------------|-------|--------------|-------|----------------|
| grease          | oil   | thrust needle roller and cage assembly | washer        | inner ring     | outer ring     | mm                   |       | kg (approx.) |       |                |
|                 | r/min |                                        |               |                |                | $E_b$                | $E_a$ | AXK11        | AS11  | WS811<br>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          |

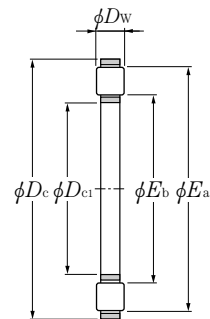
**Type 811**  
**Type 812**  
**Type 893**



**Type 811**  
**Type 812**  
**(Bearing)**



**Type 893**  
**(Bearing)**



**Type K811, type K812**  
**(Thrust needle roller and cage assy)**

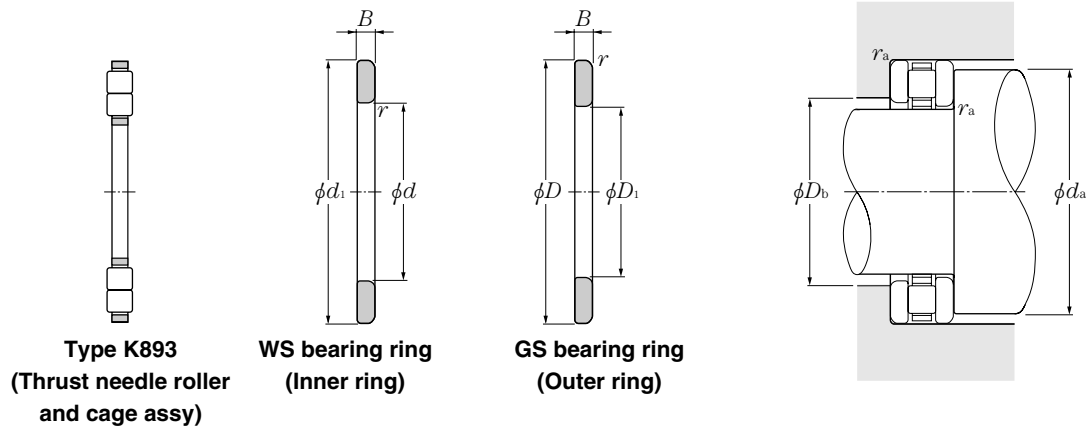
$d$  10~60mm

| Boundary dimensions |     |                       |                       |     |                      |              |                      |            |                   | Basic load ratings |             |                |               | Limiting speeds |        |
|---------------------|-----|-----------------------|-----------------------|-----|----------------------|--------------|----------------------|------------|-------------------|--------------------|-------------|----------------|---------------|-----------------|--------|
| $d$                 | $D$ | $d_1$<br>-0.2<br>+0.5 | $D_1$<br>+0.5<br>+0.2 | $T$ | $D_{c1}^{2)}$<br>E11 | $D_c$<br>a13 | $D_w$<br>0<br>-0.010 | $B$<br>h11 | $r_{s \min}^{1)}$ | dynamic<br>N       | static<br>N | dynamic<br>kgf | static<br>kgf | grease          | oil    |
| 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               | 12 900             | 28 600      | 1 310          | 2 920         | 2 800           | 11 000 |
| 17                  | 30  | 30                    | 18                    | 9   | 17                   | 30           | 3.5                  | 2.75       | 0.3               | 13 400             | 31 000      | 1 370          | 3 150         | 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      | 2 780          | 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                 | 66 000             | 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  |
| 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     | 8 350          | 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  |
| 50                  | 70  | 70                    | 52                    | 14  | 50                   | 70           | 6                    | 4          | 0.6               | 48 000             | 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  |
| 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     | 12 300         | 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  |
| 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                 | 125 000            | 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  |

Note 1) Allowable minimum chamfer dimension  $r^*$ .

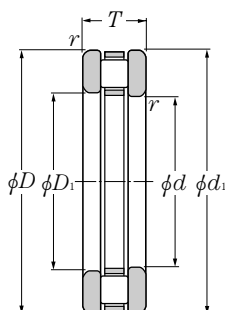
2) The dimensional tolerance for a bearing with a T2 suffix is E12.



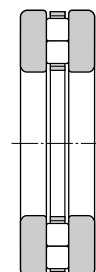


| Bearing numbers |                                             |            |            | Reference dimensions<br>mm |       | Abutment dimensions<br>mm |              |                 | Mass<br>kg        |                      |          |
|-----------------|---------------------------------------------|------------|------------|----------------------------|-------|---------------------------|--------------|-----------------|-------------------|----------------------|----------|
| bearing         | thrust cylindrical roller and cage assembly | inner ring | outer ring | $E_b$                      | $E_a$ | $d_a$<br>min              | $D_b$<br>max | $r_{as}$<br>max | 811<br>812<br>893 | K811<br>K812<br>K893 | WS<br>GS |
| 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    |
| 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    |
| 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    |
| 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    |
| 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    |

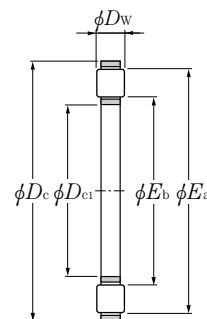
**Type 811**  
**Type 812**  
**Type 893**



**Type 811**  
**Type 812**  
**(Bearing)**



**Type 893**  
**(Bearing)**



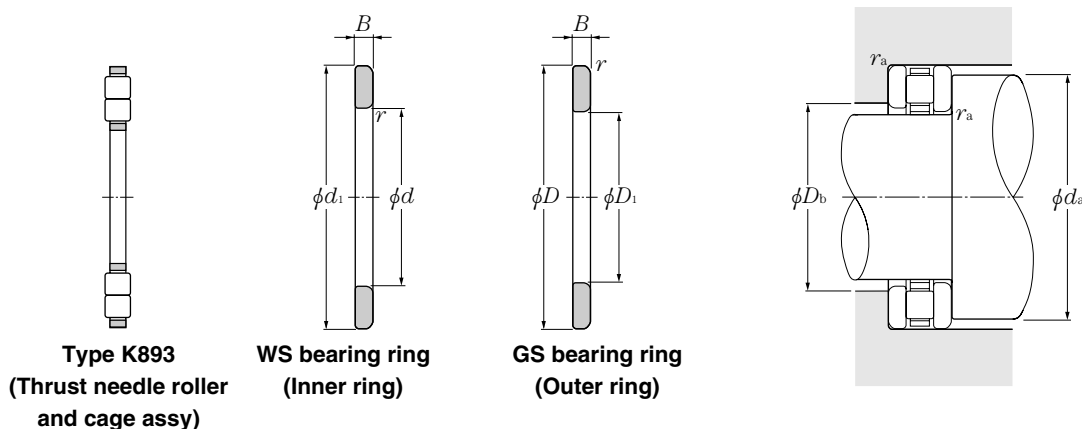
**Type K811, type K812**  
**(Thrust needle roller**  
**and cage assy)**

$d$  65~130mm

| Boundary dimensions |     |                       |                       |     |                 |              |                      |            |                         | Basic load ratings |             |                |               | Limiting speeds |       |
|---------------------|-----|-----------------------|-----------------------|-----|-----------------|--------------|----------------------|------------|-------------------------|--------------------|-------------|----------------|---------------|-----------------|-------|
| $d$                 | $D$ | $d_1$<br>-0.2<br>+0.5 | $D_1$<br>+0.5<br>+0.2 | $T$ | $D_{c1}$<br>E11 | $D_c$<br>a13 | $D_w$<br>0<br>-0.010 | $B$<br>h11 | $r_s$ min <sup>1)</sup> | dynamic<br>N       | static<br>N | dynamic<br>kgf | static<br>kgf | r/min           |       |
|                     |     |                       |                       |     |                 |              |                      |            |                         | $C_a$              | $C_{oa}$    | $C_a$          | $C_{oa}$      | grease          | oil   |
| 65                  | 90  | 90                    | 67                    | 18  | 65              | 90           | 7.5                  | 5.25       | 1                       | 73 000             | 236 000     | 7 400          | 24 100        | 780             | 3 100 |
|                     | 100 | 100                   | 67                    | 27  | 65              | 100          | 11                   | 8          | 1                       | 130 000            | 385 000     | 13 200         | 39 500        | 730             | 2 900 |
|                     | 115 | 115                   | 67                    | 30  | 65              | 115          | 9                    | 10.5       | 1.1                     | 166 000            | 635 000     | 17 000         | 64 500        | 650             | 2 600 |
| 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 |
| 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 |
| 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                       | 142 000            | 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 |
| 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   | 28 600         | 113 000       | 500             | 2 000 |
| 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 |
| 100                 | 135 | 135                   | 102                   | 25  | 100             | 135          | 11                   | 7          | 1                       | 158 000            | 555 000     | 16 100         | 57 000        | 500             | 2 000 |
|                     | 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 |
| 110                 | 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                     | 259 000            | 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 |
| 120                 | 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 |
| 130                 | 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 |

Note 1) Allowable minimum chamfer dimension  $r^*$ .

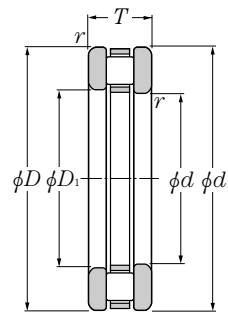
2) The dimensional tolerance for a bearing with a T2 suffix is E12.



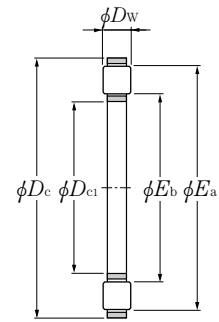
| Bearing numbers |                                             |            |            | Reference dimensions<br>mm |       | Abutment dimensions<br>mm |              |                 | Mass<br>kg        |                      |          |
|-----------------|---------------------------------------------|------------|------------|----------------------------|-------|---------------------------|--------------|-----------------|-------------------|----------------------|----------|
| bearing         | thrust cylindrical roller and cage assembly | inner ring | outer ring | $E_b$                      | $E_a$ | $d_a$<br>min              | $D_b$<br>max | $r_{as}$<br>max | 811<br>812<br>893 | K811<br>K812<br>K893 | WS<br>GS |
| 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    |
| 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    |
| 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    |
| 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    |
| 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    |
| 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    |
| 81120T2         | K81120T2                                    | WS81120    | GS81120    | 105.1                      | 128.7 | 128                       | 106          | 1               | 1.000             | 0.300                | 0.350    |
| 81220           | K81220                                      | WS81220    | GS81220    | 109.2                      | 140.0 | 139                       | 109          | 1               | 2.240             | 0.620                | 0.810    |
| 89320           | K89320                                      | WS89320    | GS89320    | 110.6                      | 163.0 | 163                       | 110          | 1.5             | 4.190             | 0.810                | 1.690    |
| 81122T2         | K81122T2                                    | WS81122    | GS81122    | 115.0                      | 138.8 | 138                       | 116          | 1               | 1.100             | 0.325                | 0.385    |
| 81222           | K81222                                      | WS81222    | GS81222    | 119.2                      | 150.0 | 149                       | 119          | 1               | 2.450             | 0.685                | 0.880    |
| 89322           | K89322                                      | WS89322    | GS89322    | 122.5                      | 183.0 | 183                       | 122          | 2               | 6.030             | 1.150                | 2.440    |
| 81124T2         | K81124T2                                    | WS81124    | GS81124    | 125.0                      | 148.8 | 148                       | 126          | 1               | 1.170             | 0.340                | 0.415    |
| 81224           | K81224                                      | WS81224    | GS81224    | 129.2                      | 160.0 | 159                       | 129          | 1               | 2.690             | 0.730                | 0.980    |
| 81126           | K81126                                      | WS81126    | GS81126    | 137.7                      | 162.4 | 162                       | 137          | 1               | 1.740             | 0.415                | 0.663    |
| 81226           | K81226                                      | WS81226    | GS81226    | 140.1                      | 179.0 | 173                       | 140          | 1.5             | 4.200             | 1.140                | 1.530    |

## Type 811

## Type 812



**Type 811  
Type 812  
(Bearing)**

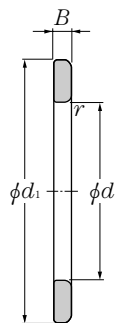


**Type K811, type K812  
(Thrust needle roller  
and cage assy)**

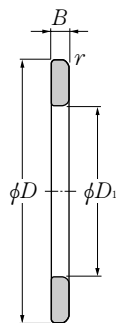
$d$  140~160mm

| Boundary dimensions |     |                           |                           |     |                 |              |                          |            |                         | Basic load ratings |             |                |               | Limiting speeds |       |
|---------------------|-----|---------------------------|---------------------------|-----|-----------------|--------------|--------------------------|------------|-------------------------|--------------------|-------------|----------------|---------------|-----------------|-------|
| $d$                 | $D$ | $d_1$<br>$-0.2$<br>$-0.5$ | $D_1$<br>$+0.5$<br>$+0.2$ | $T$ | $D_{c1}$<br>E11 | $D_c$<br>a13 | $D_w$<br>$0$<br>$-0.010$ | $B$<br>h11 | $r_s$ min <sup>1)</sup> | dynamic<br>N       | static<br>N | dynamic<br>kgf | static<br>kgf | r/min           |       |
|                     |     |                           |                           |     |                 |              |                          |            |                         | $C_a$              | $C_{oa}$    | $C_a$          | $C_{oa}$      | grease          | oil   |
| <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 |

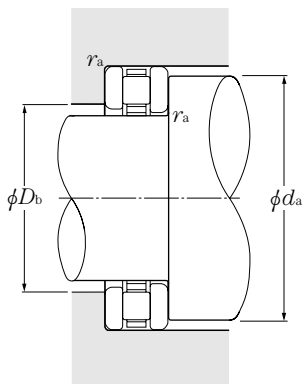
Note 1) Allowable minimum chamfer dimension  $r'$ .



**WS bearing ring  
(Inner ring)**



**GS bearing ring  
(Outer ring)**

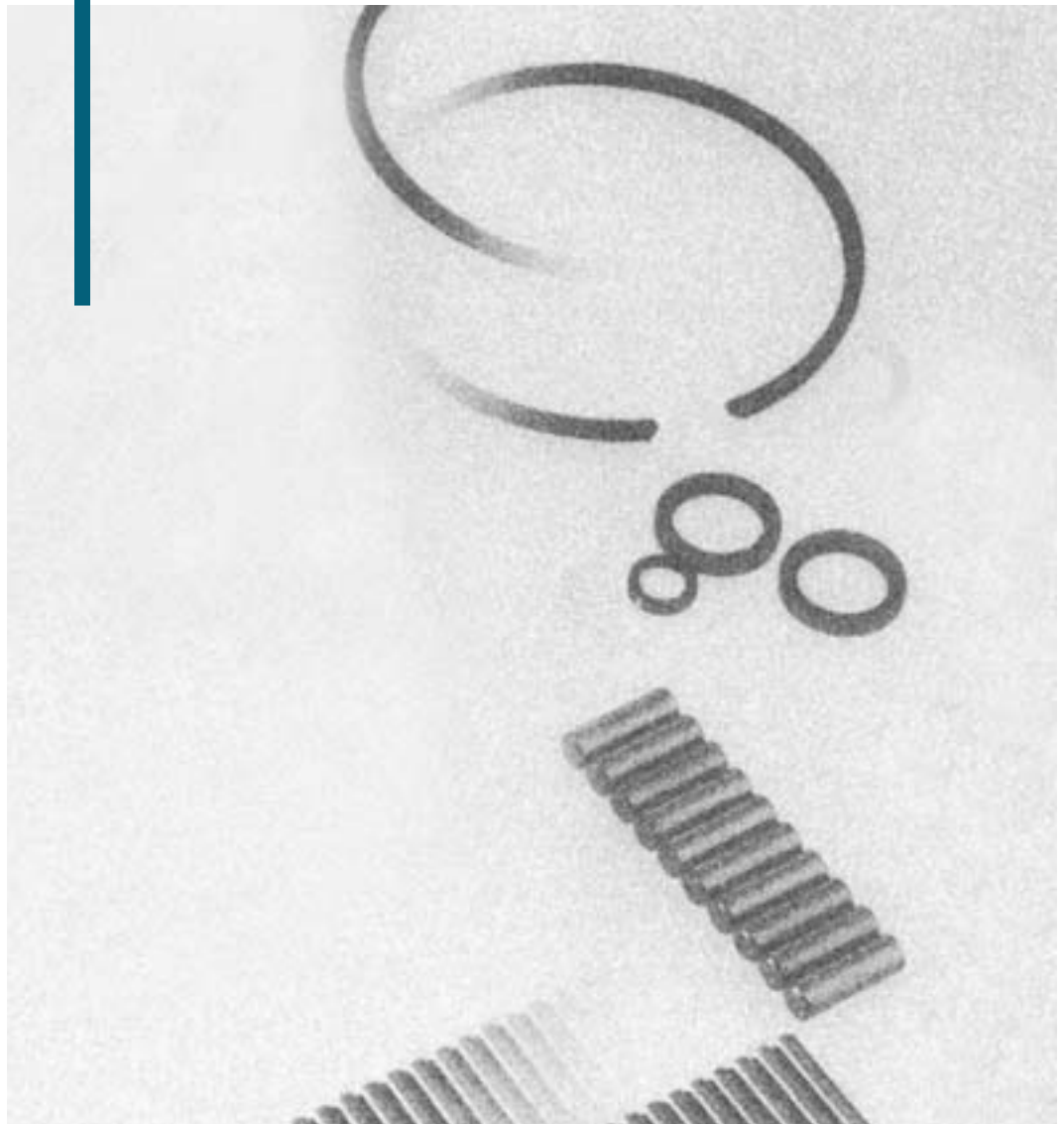


| Bearing numbers |                                                |                |                | Reference dimensions<br>mm |       | Abutment dimensions<br>mm |              |                 | Mass<br>kg        |                      |          |
|-----------------|------------------------------------------------|----------------|----------------|----------------------------|-------|---------------------------|--------------|-----------------|-------------------|----------------------|----------|
| bearing         | thrust cylindrical roller<br>and cage assembly | inner ring     | outer ring     |                            |       | $d_a$<br>min              | $D_b$<br>max | $r_{as}$<br>max | 811<br>812<br>893 | K811<br>K812<br>K893 | WS<br>GS |
|                 |                                                |                |                | $E_b$                      | $E_a$ |                           |              |                 |                   |                      |          |
| <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    |



# 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

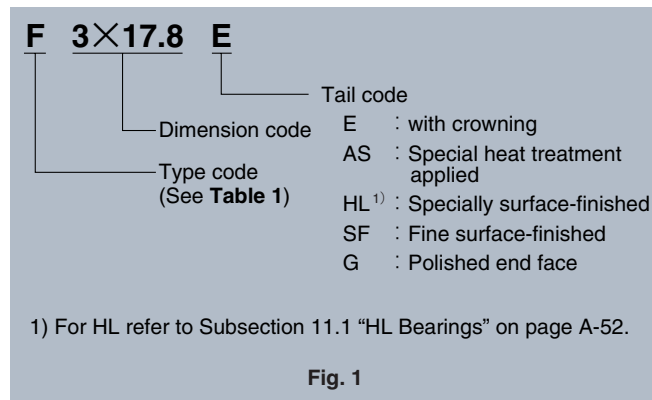
F-type needle roller bearing with flat end face is standard type, while A-type with round end face is semi-standard type. In addition to these two types, another needle roller type (nominal number with tail code E) capable of damping edge load is also available. Feel free to contact NTN for the detail thereof.

**Table 1 End face profile**

| Type | Name  | Profile                                                                           |
|------|-------|-----------------------------------------------------------------------------------|
| F    | Flat  |  |
| A    | Round |  |

### Composition of nominal code

The nominal number comprises type code (end face profile), dimension code [diameter ( $D_w$ ) $\times$ length ( $L_w$ )] and tail code.



### Needle roller tolerances

Any needle rollers are manufactured with dimensional accuracy and profile accuracy conforming to JIS B 1506 (Rollers for Roller Bearings). (Table 2)

**Table 2 Needle roller tolerances**

Unit:  $\mu\text{m}$

| Characteristics                                     | Tolerance and allowable value                     |
|-----------------------------------------------------|---------------------------------------------------|
| Tolerance for mean value of diameter $D_w$          | 0 ~ -10                                           |
| Mutual deviation of diameter $D_w$                  | 2                                                 |
| Roundness of diameter $D_w$ , variation in diameter | 1.0 ( $L_w/D_w \leq 6$ )<br>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 ~ -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                                  |                |



### Application of needle rollers

When composing a full-complement roller type needle roller bearing using standard needle rollers, shaft diameter ( $d$ ), housing hole diameter ( $D$ ), circumferential clearance ( $\Delta C$ )

and radial clearance ( $\Delta r$ ) must be determined respectively. These can be calculated as follows from needle roller diameter ( $D_w$ ) and number of rollers ( $Z$ ).

(Refer to **Fig. 2**)

Determine the minimum value of circumferential clearance ( $\Delta C$ ) using **formula (1)**. And select radial clearance ( $\Delta r$ ) according to applicable shaft diameter and operating conditions, in reference to **Table 5.1**, as the guideline, of 5.1 “**Bearing Radial Clearance**” (page A-30). In general, full-complement roller type bearing needs radial clearance larger than that in needle roller and cage assembly type roller bearing.

$$\Delta C = (0.005 \sim 0.020) \times Z \text{ mm (minimum value)} \quad (1)$$

Then, determine the minimum value of housing bore diameter ( $D$ ) and the maximum value of shaft diameter ( $d$ ) using the **formulas (2) and (3)**.

$$D = \left[ \frac{1}{\sin \left( \frac{\pi}{Z} \right)} + 1 \right] \cdot D_w + \frac{\Delta C}{\pi} \text{ mm (minimum value)} \quad (2)$$

$$d = D - 2D_w - \Delta r \text{ mm (maximum value)} \quad (3)$$

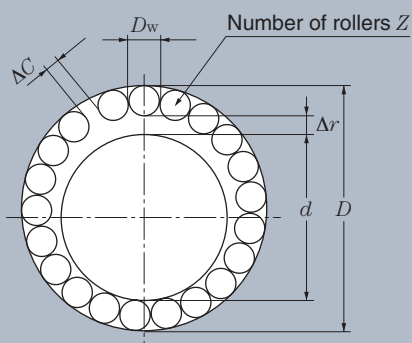


Fig. 2

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 ( $D_{w \min}$ ) 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**.

$$D = K \cdot D_{w \min} \text{ mm (max.)} \quad (4)$$

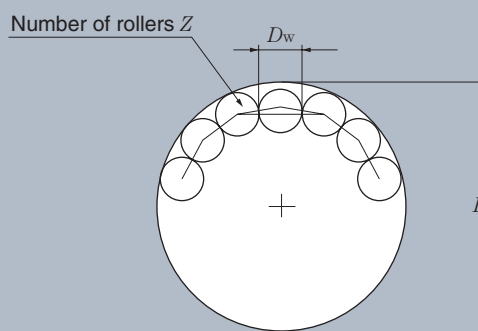


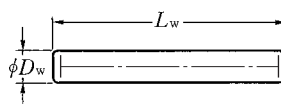
Fig. 3

Table 4 Coefficient  $K$  value

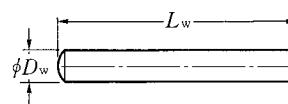
| $Z$ | $K$       | $Z$ | $K$       |
|-----|-----------|-----|-----------|
| 8   | 3.6763333 | 17  | 6.4536463 |
| 9   | 3.9709394 | 18  | 6.7689303 |
| 10  | 4.2727719 | 19  | 7.0846088 |
| 11  | 4.5789545 | 20  | 7.4006100 |
| 12  | 4.8879667 | 21  | 7.7168786 |
| 13  | 5.1989251 | 22  | 8.0333713 |
| 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<br>mm |       | Bearing numbers           |             | Mass                   | Boundary dimensions<br>mm |       | Bearing numbers           |             | Mass                   |
|---------------------------|-------|---------------------------|-------------|------------------------|---------------------------|-------|---------------------------|-------------|------------------------|
| $D_w$                     | $L_w$ | flat type                 | disk type   | kg<br>per<br>1 000 pcs | $D_w$                     | $L_w$ | flat type                 | disk type   | kg<br>per<br>1 000 pcs |
| 1.5                       | 5.8   | <b>F1.5</b> × <b>5.8</b>  | A1.5 × 5.8  | 0.080                  | <b>3</b>                  | 23.8  | <b>F3</b> × <b>23.8</b>   | A3 × 23.8   | 1.34                   |
|                           | 6.8   | <b>F1.5</b> × <b>6.8</b>  | A1.5 × 6.8  | 0.090                  |                           | 25.8  | <b>F3</b> × <b>25.8</b>   | A3 × 25.8   | 1.45                   |
|                           | 7.8   | <b>F1.5</b> × <b>7.8</b>  | A1.5 × 7.8  | 0.104                  |                           | 27.8  | <b>F3</b> × <b>27.8</b>   | A3 × 27.8   | 1.56                   |
|                           | 9.8   | <b>F1.5</b> × <b>9.8</b>  | A1.5 × 9.8  | 0.131                  | <b>3.5</b>                | 11.8  | <b>F3.5</b> × <b>11.8</b> | A3.5 × 11.8 | 0.849                  |
|                           | 11.8  | <b>F1.5</b> × <b>11.8</b> | A1.5 × 11.8 | 0.159                  |                           | 13.8  | <b>F3.5</b> × <b>13.8</b> | A3.5 × 13.8 | 1.00                   |
|                           | 13.8  | <b>F1.5</b> × <b>13.8</b> | A1.5 × 13.8 | 0.186                  |                           | 15.8  | <b>F3.5</b> × <b>15.8</b> | A3.5 × 15.8 | 1.15                   |
| 2                         | 6.8   | <b>F2</b> × <b>6.8</b>    | A2 × 6.8    | 0.158                  |                           | 17.8  | <b>F3.5</b> × <b>17.8</b> | A3.5 × 17.8 | 1.30                   |
|                           | 7.8   | <b>F2</b> × <b>7.8</b>    | A2 × 7.8    | 0.183                  |                           | 19.8  | <b>F3.5</b> × <b>19.8</b> | A3.5 × 19.8 | 1.45                   |
|                           | 9.8   | <b>F2</b> × <b>9.8</b>    | A2 × 9.8    | 0.232                  |                           | 21.8  | <b>F3.5</b> × <b>21.8</b> | A3.5 × 21.8 | 1.60                   |
|                           | 11.8  | <b>F2</b> × <b>11.8</b>   | A2 × 11.8   | 0.281                  |                           | 23.8  | <b>F3.5</b> × <b>23.8</b> | A3.5 × 23.8 | 1.75                   |
|                           | 13.8  | <b>F2</b> × <b>13.8</b>   | A2 × 13.8   | 0.330                  |                           | 25.8  | <b>F3.5</b> × <b>25.8</b> | A3.5 × 25.8 | 1.90                   |
|                           | 15.8  | <b>F2</b> × <b>15.8</b>   | A2 × 15.8   | 0.379                  |                           | 29.8  | <b>F3.5</b> × <b>29.8</b> | A3.5 × 29.8 | 2.20                   |
|                           | 17.8  | <b>F2</b> × <b>17.8</b>   | A2 × 17.8   | 0.428                  |                           | 31.8  | <b>F3.5</b> × <b>31.8</b> | A3.5 × 31.8 | 2.35                   |
|                           | 19.8  | <b>F2</b> × <b>19.8</b>   | A2 × 19.8   | 0.477                  |                           | 34.8  | <b>F3.5</b> × <b>34.8</b> | A3.5 × 34.8 | 2.58                   |
| 2.5                       | 7.8   | <b>F2.5</b> × <b>7.8</b>  | A2.5 × 7.8  | 0.284                  | <b>4</b>                  | 13.8  | <b>F4</b> × <b>13.8</b>   | A4 × 13.8   | 1.27                   |
|                           | 9.8   | <b>F2.5</b> × <b>9.8</b>  | A2.5 × 9.8  | 0.351                  |                           | 15.8  | <b>F4</b> × <b>15.8</b>   | A4 × 15.8   | 1.50                   |
|                           | 11.8  | <b>F2.5</b> × <b>11.8</b> | A2.5 × 11.8 | 0.438                  |                           | 17.8  | <b>F4</b> × <b>17.8</b>   | A4 × 17.8   | 1.70                   |
|                           | 13.8  | <b>F2.5</b> × <b>13.8</b> | A2.5 × 13.8 | 0.514                  |                           | 19.8  | <b>F4</b> × <b>19.8</b>   | A4 × 19.8   | 1.89                   |
|                           | 15.8  | <b>F2.5</b> × <b>15.8</b> | A2.5 × 15.8 | 0.591                  |                           | 21.8  | <b>F4</b> × <b>21.8</b>   | A4 × 21.8   | 2.09                   |
|                           | 17.8  | <b>F2.5</b> × <b>17.8</b> | A2.5 × 17.8 | 0.668                  |                           | 23.8  | <b>F4</b> × <b>23.8</b>   | A4 × 23.8   | 2.26                   |
|                           | 19.8  | <b>F2.5</b> × <b>19.8</b> | A2.5 × 19.8 | 0.745                  |                           | 25.8  | <b>F4</b> × <b>25.8</b>   | A4 × 25.8   | 2.48                   |
|                           | 21.8  | <b>F2.5</b> × <b>21.8</b> | A2.5 × 21.8 | 0.821                  |                           | 27.8  | <b>F4</b> × <b>27.8</b>   | A4 × 27.8   | 2.68                   |
|                           | 23.8  | <b>F2.5</b> × <b>23.8</b> | A2.5 × 23.8 | 0.898                  |                           | 29.8  | <b>F4</b> × <b>29.8</b>   | A4 × 29.8   | 2.87                   |
| 3                         | 9.8   | <b>F3</b> × <b>9.8</b>    | A3 × 9.8    | 0.556                  |                           | 31.8  | <b>F4</b> × <b>31.8</b>   | A4 × 31.8   | 3.07                   |
|                           | 11.8  | <b>F3</b> × <b>11.8</b>   | A3 × 11.8   | 0.671                  |                           | 34.8  | <b>F4</b> × <b>34.8</b>   | A4 × 34.8   | 3.31                   |
|                           | 13.8  | <b>F3</b> × <b>13.8</b>   | A3 × 13.8   | 0.784                  |                           | 37.8  | <b>F4</b> × <b>37.8</b>   | A4 × 37.8   | 3.62                   |
|                           | 15.8  | <b>F3</b> × <b>15.8</b>   | A3 × 15.8   | 0.897                  |                           | 39.8  | <b>F4</b> × <b>39.8</b>   | A4 × 39.8   | 3.82                   |
|                           | 17.8  | <b>F3</b> × <b>17.8</b>   | A3 × 17.8   | 1.01                   | <b>4.5</b>                | 17.8  | <b>F4.5</b> × <b>17.8</b> | A4.5 × 17.8 | 2.11                   |
|                           | 19.8  | <b>F3</b> × <b>19.8</b>   | A3 × 19.8   | 1.12                   |                           | 19.8  | <b>F4.5</b> × <b>19.8</b> | A4.5 × 19.8 | 2.36                   |
|                           | 21.8  | <b>F3</b> × <b>21.8</b>   | A3 × 21.8   | 1.23                   |                           | 21.8  | <b>F4.5</b> × <b>21.8</b> | A4.5 × 21.8 | 2.61                   |

$D_w$  4.5~5mm

| Boundary dimensions<br>mm |       | Bearing numbers  |           | Mass                   |
|---------------------------|-------|------------------|-----------|------------------------|
| $D_w$                     | $L_w$ | flat type        | disk type | kg<br>per<br>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.

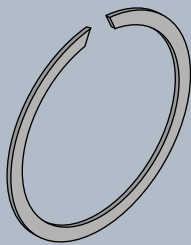


Fig. 1 WR snap ring

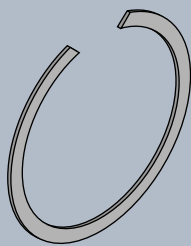


Fig. 2 BR snap ring

### Composition of nominal number

The snap ring nominal 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. On occasion, snap ring is difficult to remove, but limited to a portion in which a pull-out

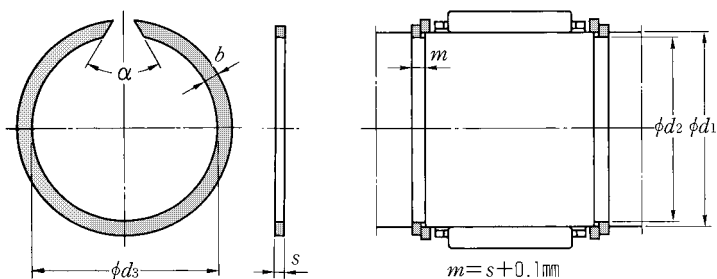
tool can not be inserted easily. In such a case, it is necessary to consider the use of general snap rings specified in JIS B 2804 (C-type snap rings) or B 2806 (C-type concentric snap rings).

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°                           |

## For shaft

### Type WR

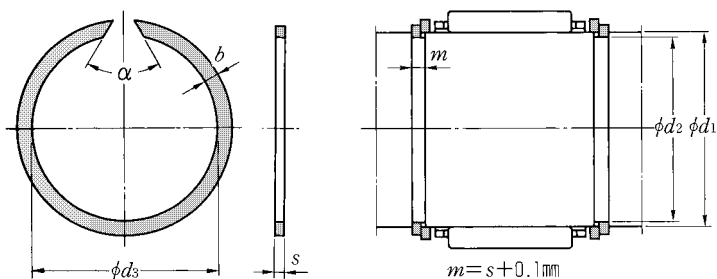


| Bearing numbers | Boundary dimensions |              |      |                   |                                    | Limiting speeds<br>r/min |
|-----------------|---------------------|--------------|------|-------------------|------------------------------------|--------------------------|
|                 | $d_1$               | $d_3$<br>max | $b$  | $s$<br>$\pm 0.06$ | $d_2$                              |                          |
| 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</sup> <sub>-0.09</sub>  | 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 <sup>0</sup> <sub>-0.11</sub> | 45 900                   |
| WR15            | 15                  | 14           | 1.75 | 1.2               | 14.4                               | 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</sup> <sub>-0.13</sub>   | 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 <sup>0</sup> <sub>-0.16</sub> | 13 300                   |
| WR35            | 35                  | 33.2         | 2.3  | 1.5               | 33.8                               | 10 700                   |

| Bearing numbers | Boundary dimensions |              |     |                   |                                    | Limiting speeds<br>r/min |
|-----------------|---------------------|--------------|-----|-------------------|------------------------------------|--------------------------|
|                 | $d_1$               | $d_3$<br>max | $b$ | $s$<br>$\pm 0.06$ | $d_2$                              |                          |
| 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</sup> <sub>-0.16</sub> | 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</sup> <sub>-0.19</sub> | 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 <sup>0</sup> <sub>-0.22</sub>   | 2 000                    |
| WR 95           | 95                  | 92           | 3.4 | 2.5               | 93                                 | 1 750                    |
| WR100           | 100                 | 97           | 3.4 | 2.5               | 98                                 | 1 560                    |

## For shaft

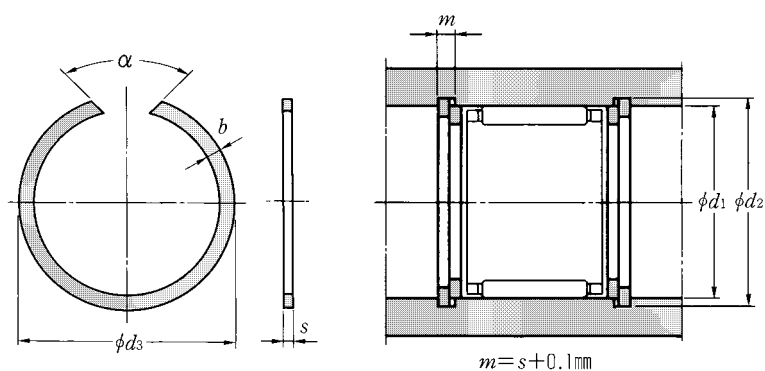
### Type WR



| Bearing numbers | Boundary dimensions |              |     |                   |       | Limiting speeds<br>r/min |
|-----------------|---------------------|--------------|-----|-------------------|-------|--------------------------|
|                 | $d_1$               | $d_3$<br>max | $b$ | $s$<br>$\pm 0.06$ | $d_2$ |                          |
| 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 | 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 | 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   | 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   | 410                      |
| 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   | 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   | 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

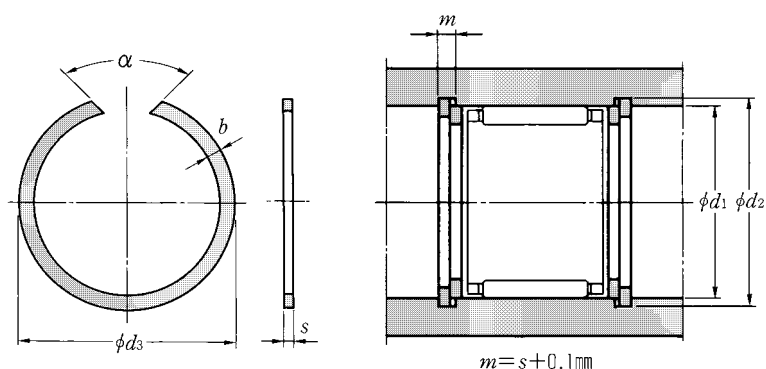


| Bearing numbers | Boundary dimensions |              |           |                   |       |              |
|-----------------|---------------------|--------------|-----------|-------------------|-------|--------------|
|                 | $d_1$               | $d_3$<br>min | $b$<br>mm | $s$<br>$\pm 0.06$ | $d_2$ |              |
| BR 7            | 7                   | 7.5          | 1         | 0.8               | 7.3   | $+0.09$<br>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  | $+0.11$<br>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  | $+0.13$<br>0 |
| BR15            | 15                  | 15.8         | 1.3       | 1                 | 15.5  |              |
| 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  | $+0.16$<br>0 |
| 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  | $+0.19$<br>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  | $+0.16$<br>0 |
| 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    | $+0.16$<br>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 |              |           |                   |       |              |
|-----------------|---------------------|--------------|-----------|-------------------|-------|--------------|
|                 | $d_1$               | $d_3$<br>min | $b$<br>mm | $s$<br>$\pm 0.06$ | $d_2$ |              |
| BR35            | 35                  | 36.4         | 2.3       | 1.5               | 36    | $+0.16$<br>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  | $+0.19$<br>0 |
| 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  | $+0.19$<br>0 |
| 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  |              |
| BR47            | 47                  | 48.8         | 2.3       | 1.5               | 48.2  | $+0.19$<br>0 |
| 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  | $+0.19$<br>0 |
| 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  | $+0.19$<br>0 |
| 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  |              |
| BR62            | 62                  | 64.3         | 2.3       | 1.5               | 63.5  | $+0.19$<br>0 |
| 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 |              |     |                   |       |
|-----------------|---------------------|--------------|-----|-------------------|-------|
|                 | $d_1$               | $d_3$<br>min | $b$ | $s$<br>$\pm 0.06$ | $d_2$ |
| 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 |              |     |                   |       |
|-----------------|---------------------|--------------|-----|-------------------|-------|
|                 | $d_1$               | $d_3$<br>min | $b$ | $s$<br>$\pm 0.06$ | $d_2$ |
| 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 |              |                             |   |       |
|-----------------|---------------------|--------------|-----------------------------|---|-------|
|                 | $d_1$               | $d_3$<br>min | mm<br>$b$ $s$<br>$\pm 0.06$ |   | $d_2$ |
| <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   |
| <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   |
| <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   |
| <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   |
| <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 an non-lubrication environment, are also manufactured. Feel free to contact **NTN** for the detail of these seal types.

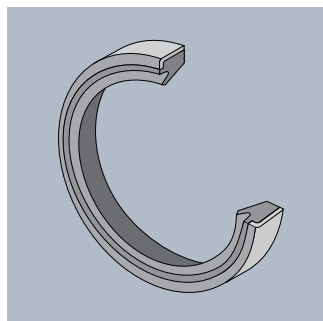


Fig. 1 Type G (LEG)

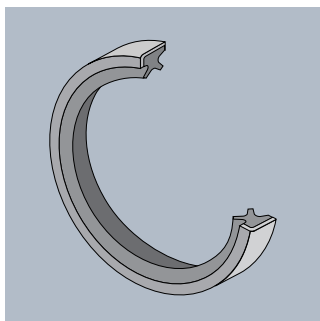


Fig. 2 Type GD (LEGD)

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 nominal number

Nominal seal number is composed of type code (G, GD) and dimension code (bore dia. × outer dia. × width).

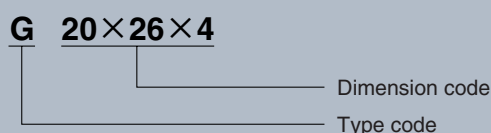


Fig. 3

### 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.**

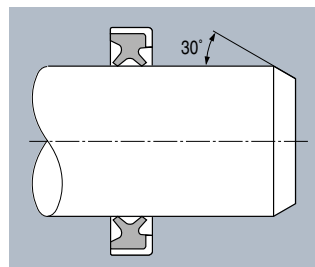


Fig. 4

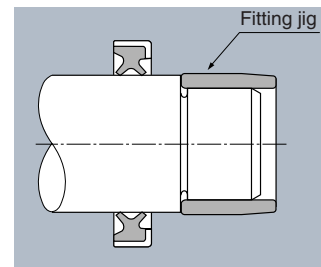


Fig. 5

### Seal application examples

**Figs. 6 to 8** illustrate design examples using these seals.

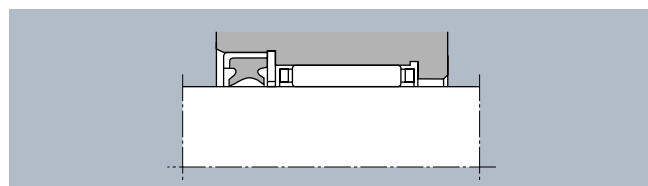


Fig. 6

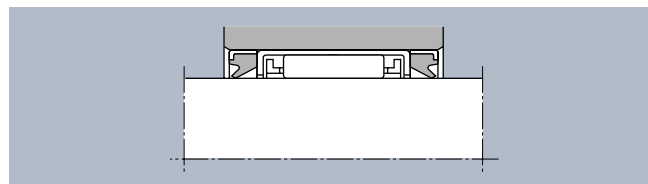


Fig. 7

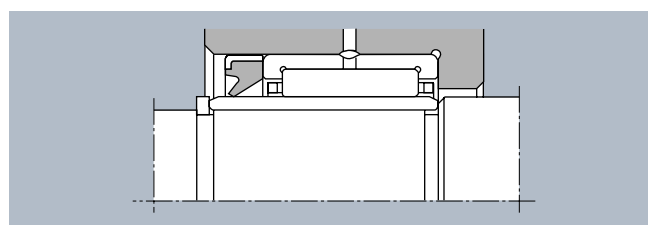
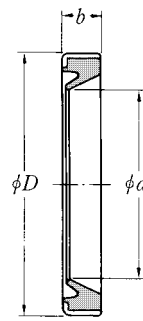
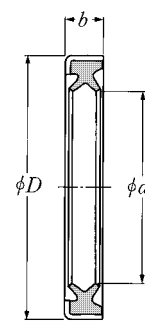


Fig. 8

Type G  
Type GD



Type G



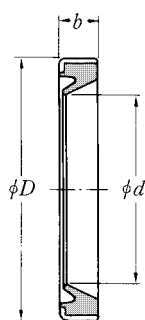
Type GD

| Bearing numbers |           | Boundary dimensions<br>mm |                 |                | Mass<br>×10 <sup>-3</sup> kg |      |
|-----------------|-----------|---------------------------|-----------------|----------------|------------------------------|------|
| Type G          | Type GD   | d                         | D <sup>1)</sup> | b<br>+0.2<br>0 | G                            | GD   |
| G 4×8×2         | —         | 4                         | 8               | 2              | 0.18                         | —    |
| G 5×9×2         | —         | 5                         | 9               | 2              | 0.19                         | —    |
| G 5×10×2        | —         | 5                         | 10              | 2              | 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              | 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              | 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  |

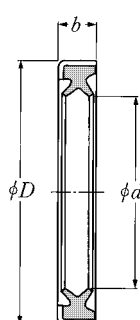
| Bearing numbers |           | Boundary dimensions<br>mm |                 |                | Mass<br>×10 <sup>-3</sup> kg |     |
|-----------------|-----------|---------------------------|-----------------|----------------|------------------------------|-----|
| Type G          | Type GD   | d                         | D <sup>1)</sup> | b<br>+0.2<br>0 | 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              | 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              | 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              | 4.8                          | 4.7 |
| G42×52×4        | GD42×52×4 | 42                        | 52              | 4              | 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

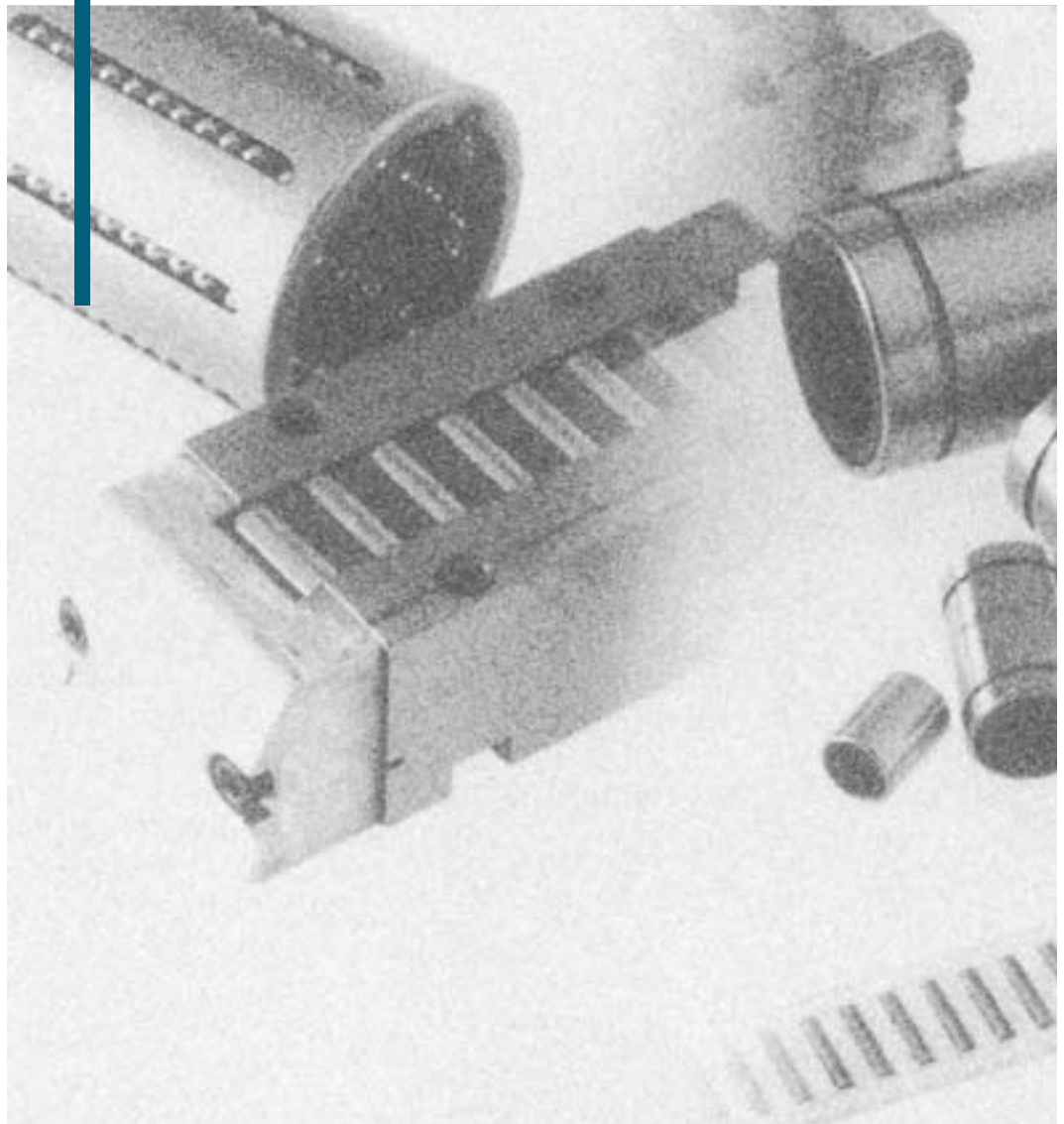


Type GD

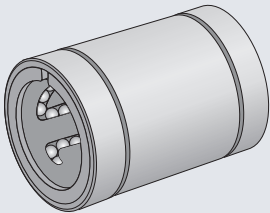
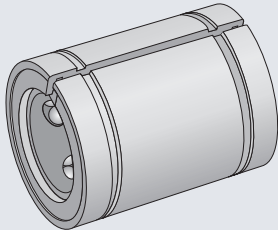
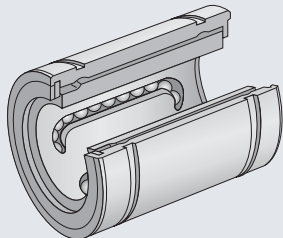
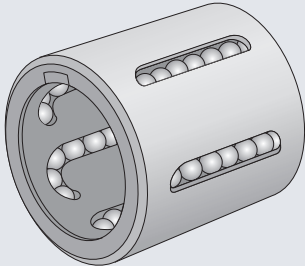
| Bearing numbers |           | Boundary dimensions<br>mm |                                 |                            | Mass<br>×10 <sup>-3</sup> kg |     |
|-----------------|-----------|---------------------------|---------------------------------|----------------------------|------------------------------|-----|
| Type G          | Type GD   | d                         | D <sup>1)</sup>                 | b<br><sub>+0.2<br/>0</sub> | G                            | GD  |
| G43×53×4        | GD43×53×4 | 43                        | 53                              | 4                          | 4.8                          | 4.3 |
| G45×52×4        | GD45×52×4 | 45                        | 52                              | 4                          | 3.8                          | 3.8 |
| G45×55×4        | GD45×55×4 | 45                        | 55 <sub>+0.173<br/>+0.053</sub> | 4                          | 5.2                          | 5.5 |
| G50×58×4        | GD50×58×4 | 50                        | 58                              | 4                          | 4.5                          | 5.2 |
| G50×62×5        | GD50×62×5 | 50                        | 62                              | 5                          | 10.4                         | 10  |

Note 1) The outer diameter tolerance is the mean value of the measured values at two measuring points.

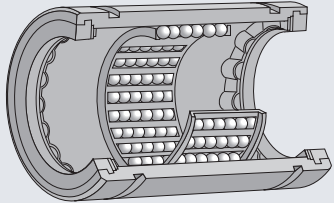
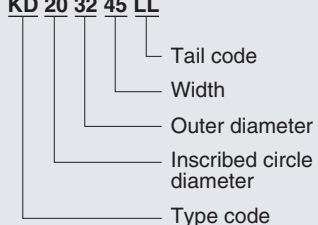
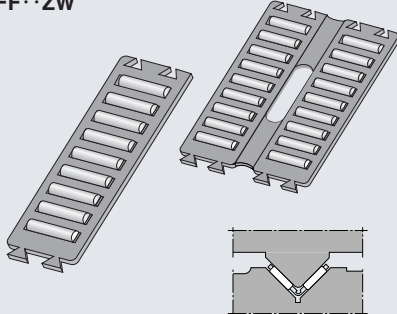
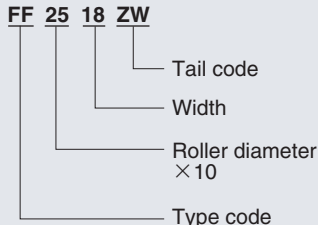
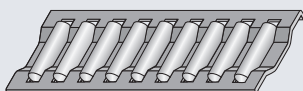
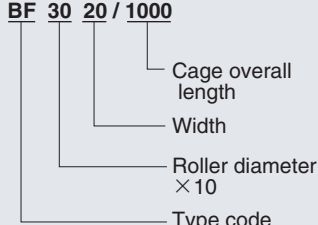
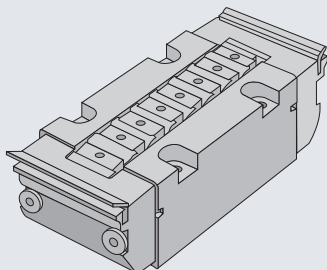
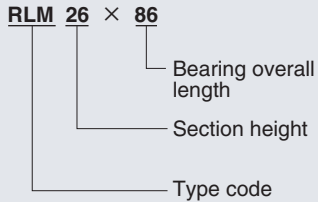
## **LINEAR BALL BEARINGS: Solid, Drawn Cup, Stroke, Linear Flat Roller, and Linear Roller Bearing Types**



## Linear Ball Bearings

| Type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Applied shaft diameter (mm)                                      | Composition of nominal number                                                                                                                                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>KLM</b><br> <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>                                                                                                                                                                                                                                                                                                                                             | $\phi 3 \sim \phi 40$                                            | <p><b>KLM 06 L</b></p> <ul style="list-style-type: none"> <li>Tail code</li> <li>Inscribed circle diameter</li> <li>Type code</li> </ul>                       |
| <b>KLM · · S</b><br> <p>his 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>                                                                                                                                                      | $\phi 16 \sim \phi 40$                                           | <p><b>KLM 30 S</b></p> <ul style="list-style-type: none"> <li>Tail code</li> <li>Inscribed circle diameter</li> <li>Type code</li> </ul>                       |
| <b>KLM · · P</b><br> <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 assy 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> | $\phi 16 \sim \phi 40$                                           | <p><b>KLM 30 P LL</b></p> <ul style="list-style-type: none"> <li>Tail code</li> <li>Tail code</li> <li>Inscribed circle diameter</li> <li>Type code</li> </ul> |
| <b>KH</b><br> <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>                                                                                                                                                                                             | $\phi 6 \sim \phi 50$<br><br>With seal<br>$\phi 10 \sim \phi 50$ | <p><b>KH 20 30 LL</b></p> <ul style="list-style-type: none"> <li>Tail code</li> <li>Width</li> <li>Inscribed circle diameter</li> <li>Type code</li> </ul>     |

| Components                                                                   | Infinite motion | Finite motion | Rotating motion | Remarks                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------------------------------------------------------------------------------|-----------------|---------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Inscribed circle diameter: $\phi 6$<br>L: Single-side seal                   | ○               | —             | ×               | <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>Furthermore, the operating temperature shall be held within the range of -25 to 100°C to prevent deterioration of seal and grease.</p> <p>These bearing types can't rotate.</p> |
| Inscribed circle diameter: $\phi 6$<br>S: Clearance-adjustable type          | ○               | —             | ×               |                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Inscribed circle diameter: $\phi 30$<br>P: Open type<br>LL: Double-side seal | ○               | —             | ×               |                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Inscribed circle diameter: $\phi 20$<br>Width: 30<br>LL: Double-side seal    | ○               | —             | ×               |                                                                                                                                                                                                                                                                                                                                                                                                                           |

| Type                                                                                                             | Applied shaft diameter (mm)               | Composition of nominal number                                                                                   |
|------------------------------------------------------------------------------------------------------------------|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| <b>KD</b><br>                   | Shaft diameter<br>$\phi 10 \sim \phi 80$  | <b>KD 20 32 45 LL</b><br>    |
| <b>FF</b><br><b>FF··ZW</b><br> | Roller diameter<br>$\phi 2 \sim \phi 3.5$ | <b>FF 25 18 ZW</b><br>      |
| <b>BF (RF)</b><br>            | Roller diameter<br>$\phi 3 \sim \phi 7$   | <b>BF 30 20 / 1000</b><br> |
| <b>RLM</b><br>                | Section height<br>16~38                   | <b>RLM 26 × 86</b><br>     |



| Components                                                                     | Infinite motion | Finite motion | Rotating motion | Remarks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------------------------------------------------------------------|-----------------|---------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Inscribed circle diameter: $\phi 20$<br>Outer diameter: $\phi 32$<br>Width: 45 | —               | ○             | ○               | The operating temperature shall be held within the range of -25 to 100°C, to prevent deterioration of seal and grease.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Roller diameter: f2.5<br>Width: 18<br>ZW: Double-row type                      | ○               | —             | ×               | 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: f3<br>Width: 20<br>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.<br><br>The standard length of the bearing unit with BF cage is 1000 mm.<br>The standard length of the bearing unit with RF cage is 705 mm.<br>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<br>Bearing overall length: 86                               | ○               | —             | ×               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

## Linear Ball Bearings, Solid and Drawn Cup 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.

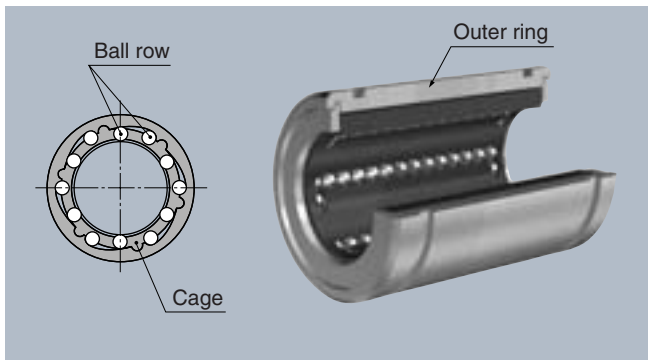


Fig. 1

### Dimensional accuracy

The respective accuracy of the boundary dimensions, inscribed circle diameter ( $F_w$ ), outer diameter ( $D$ ), and width ( $C$ ) of **Type KLM** (solid type bearing) are as described in applicable Dimensions Table. Same bearing with higher dimensional accuracy is offerable on special request. Feel free to contact **NTN** when such a bearing is needed.

**For Type KH** (drawn cup type), its outer ring is so thin-walled that it deforms inevitably to some extent in the manufacturing processes, particularly heat-treating process, but it is so designed as to be restored normally from such deformation and fulfill its specific function with the required accuracy by being press-fitted in a housing with the required dimensional accuracy.

Feel free to contact **NTN** for the method of measuring the dimensional accuracy.

### Bearing fit

The use of a shaft or a housing with the dimensional tolerance shown in **Table 1** would ensure proper radial clearance. Where further small radial clearance is wanted or preload is applied, the radial clearance is adjusted using a split housing or otherwise bearing fit required for smaller clearance or preload is selected.

Table 1 Bearing fit

| Type                        | Shaft   | Housing                                                          |
|-----------------------------|---------|------------------------------------------------------------------|
| series KLM<br>Solid type    | g6 (g5) | H7 (H6)                                                          |
| series HK<br>Drawn-cup type | h6 (j5) | H7 (H6) - steel series -<br>K7 (K6) - light metal alloy series - |

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

| Characteristics            | Shaft    | Housing |
|----------------------------|----------|---------|
| Roundness (max)            | IT3      | IT4     |
| Cylindricity (max)         | IT2      | IT4     |
| Surface roughness (max.)   | 0.4a     | 1.6a    |
| Surface hardness           | HRC58~64 | —       |
| Hardened layer depth (min) | 0.4mm    | —       |

### How to mount

The housing for **Type KLM** (solid type) can't be fixed perfectly with interference only and, therefore, must be fixed in axial direction using a snap ring.

On the other hand, **Type KH** (drawn cup type) needs no axial fixing by a snap ring because it is press-fitted in a housing with interference. For press-fitting, press the outer ring at its stamped mark side(hardened side) using a mandrel illustrated in **Fig.2**.

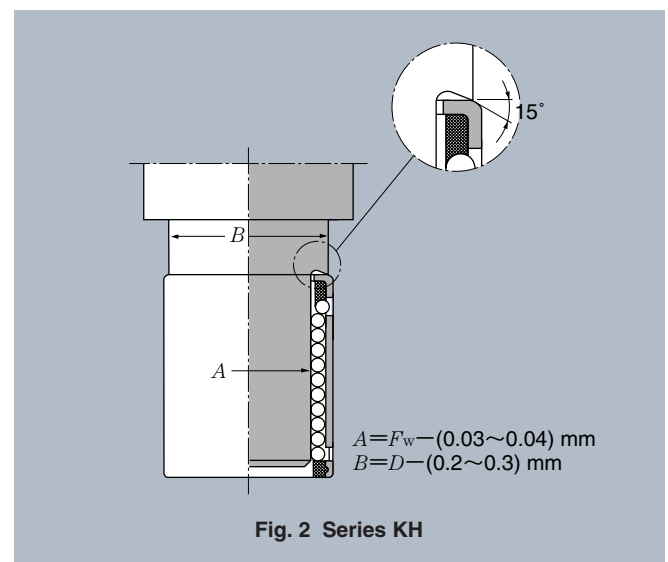


Fig. 2 Series KH

### 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 KLM

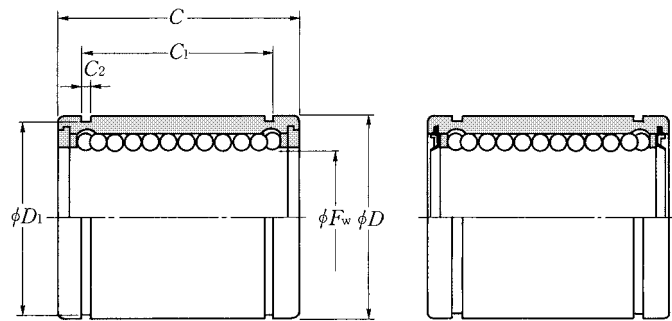
Type KLM··LL

Type KLM··S

Type KLM··SLL

Type KLM··P

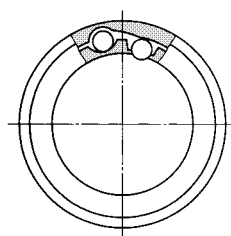
Type KLM··PLL



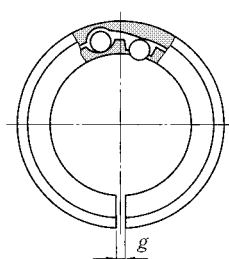
With seal

 $F_w$  3~35mm

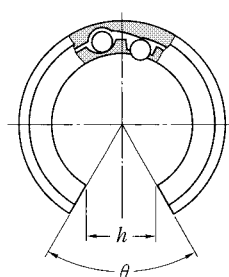
| Boundary dimensions                                              |                                                                  |                                                                  |                      |       |       |       |      |     |          | Basic load ratings |        |          |        | Bearing numbers | Number of ball rows | Mass kg (approx.) |
|------------------------------------------------------------------|------------------------------------------------------------------|------------------------------------------------------------------|----------------------|-------|-------|-------|------|-----|----------|--------------------|--------|----------|--------|-----------------|---------------------|-------------------|
| $F_w$                                                            | $D$                                                              | $C$                                                              | mm                   |       |       | $D_1$ | $g$  | $h$ | $\theta$ | dynamic            | static | dynamic  | static |                 |                     |                   |
|                                                                  |                                                                  |                                                                  | $C_1$<br>$\pm 0.240$ | $C_2$ | $C_r$ |       |      |     |          | $C_{or}$           | $C_r$  | $C_{or}$ |        |                 |                     |                   |
| <b>3</b><br>$\begin{smallmatrix} 0 \\ -0.008 \end{smallmatrix}$  | <b>7</b><br>$\begin{smallmatrix} 0 \\ -0.010 \end{smallmatrix}$  | <b>10</b><br>$\begin{smallmatrix} 0 \\ -0.120 \end{smallmatrix}$ | —                    | —     | —     | —     | —    | —   | —        | 51                 | 40     | 5        | 4      | <b>KLM03</b>    | 4                   | 0.002             |
| <b>4</b><br>$\begin{smallmatrix} 0 \\ -0.008 \end{smallmatrix}$  | <b>8</b><br>$\begin{smallmatrix} 0 \\ -0.010 \end{smallmatrix}$  | <b>12</b><br>$\begin{smallmatrix} 0 \\ -0.120 \end{smallmatrix}$ | —                    | —     | —     | —     | —    | —   | —        | 71                 | 52     | 7        | 5.5    | <b>KLM04</b>    | 4                   | 0.003             |
| <b>5</b><br>$\begin{smallmatrix} 0 \\ -0.009 \end{smallmatrix}$  | <b>10</b><br>$\begin{smallmatrix} 0 \\ -0.010 \end{smallmatrix}$ | <b>15</b><br>$\begin{smallmatrix} 0 \\ -0.120 \end{smallmatrix}$ | —                    | —     | —     | —     | —    | —   | —        | 118                | 90     | 12       | 9      | <b>KLM05</b>    | 4                   | 0.005             |
| <b>6</b><br>$\begin{smallmatrix} 0 \\ -0.009 \end{smallmatrix}$  | <b>12</b><br>$\begin{smallmatrix} 0 \\ -0.010 \end{smallmatrix}$ | <b>19</b><br>$\begin{smallmatrix} 0 \\ -0.120 \end{smallmatrix}$ | 13.3                 | 1.1   | 11.5  | —     | —    | —   | —        | 130                | 107    | 13       | 11     | <b>KLM06</b>    | 4                   | 0.009             |
| <b>8</b><br>$\begin{smallmatrix} 0 \\ -0.009 \end{smallmatrix}$  | <b>15</b><br>$\begin{smallmatrix} 0 \\ -0.010 \end{smallmatrix}$ | <b>17</b><br>$\begin{smallmatrix} 0 \\ -0.120 \end{smallmatrix}$ | 11.3                 | 1.1   | 14.3  | —     | —    | —   | —        | 116                | 94     | 12       | 9.5    | <b>KLM08</b>    | 4                   | 0.012             |
|                                                                  | <b>15</b><br>$\begin{smallmatrix} 0 \\ -0.010 \end{smallmatrix}$ | <b>24</b><br>$\begin{smallmatrix} 0 \\ -0.120 \end{smallmatrix}$ | 17.3                 | 1.1   | 14.3  | —     | —    | —   | —        | 234                | 187    | 24       | 19     | <b>KLM08-1</b>  | 4                   | 0.017             |
| <b>10</b><br>$\begin{smallmatrix} 0 \\ -0.009 \end{smallmatrix}$ | <b>19</b><br>$\begin{smallmatrix} 0 \\ -0.012 \end{smallmatrix}$ | <b>29</b><br>$\begin{smallmatrix} 0 \\ -0.120 \end{smallmatrix}$ | 21.7                 | 1.3   | 18    | —     | —    | —   | —        | 435                | 297    | 45       | 30     | <b>KLM10</b>    | 4                   | 0.028             |
| <b>12</b><br>$\begin{smallmatrix} 0 \\ -0.009 \end{smallmatrix}$ | <b>22</b><br>$\begin{smallmatrix} 0 \\ -0.012 \end{smallmatrix}$ | <b>32</b><br>$\begin{smallmatrix} 0 \\ -0.120 \end{smallmatrix}$ | 22.7                 | 1.3   | 21    | —     | —    | —   | —        | 480                | 380    | 49       | 39     | <b>KLM12</b>    | 5                   | 0.042             |
| <b>13</b><br>$\begin{smallmatrix} 0 \\ -0.009 \end{smallmatrix}$ | <b>23</b><br>$\begin{smallmatrix} 0 \\ -0.012 \end{smallmatrix}$ | <b>32</b><br>$\begin{smallmatrix} 0 \\ -0.120 \end{smallmatrix}$ | 22.7                 | 1.3   | 22    | —     | —    | —   | —        | 540                | 455    | 55       | 47     | <b>KLM13</b>    | 5                   | 0.045             |
| <b>16</b><br>$\begin{smallmatrix} 0 \\ -0.009 \end{smallmatrix}$ | <b>28</b>                                                        | <b>37</b>                                                        | 26.5                 | 1.6   | 27    | —     | —    | —   | —        | 875                | 670    | 89       | 68     | <b>KLM16</b>    | 5                   | 0.075             |
|                                                                  | <b>28</b><br>$\begin{smallmatrix} 0 \\ -0.012 \end{smallmatrix}$ | <b>37</b><br>$\begin{smallmatrix} 0 \\ -0.120 \end{smallmatrix}$ | 26.5                 | 1.6   | 27    | 0.6   | —    | —   | —        | 875                | 670    | 89       | 68     | <b>KLM16S</b>   | 5                   | 0.075             |
|                                                                  | <b>28</b>                                                        | <b>37</b>                                                        | 26.5                 | 1.6   | 27    | —     | 8.2  | 60° | —        | 875                | 670    | 89       | 68     | <b>KLM16P</b>   | 4                   | 0.062             |
| <b>20</b><br>$\begin{smallmatrix} 0 \\ -0.010 \end{smallmatrix}$ | <b>32</b>                                                        | <b>42</b>                                                        | 30.3                 | 1.6   | 30.5  | —     | —    | —   | —        | 1 190              | 985    | 121      | 100    | <b>KLM20</b>    | 6                   | 0.10              |
|                                                                  | <b>32</b><br>$\begin{smallmatrix} 0 \\ -0.014 \end{smallmatrix}$ | <b>42</b><br>$\begin{smallmatrix} 0 \\ -0.120 \end{smallmatrix}$ | 30.3                 | 1.6   | 30.5  | 0.6   | —    | —   | —        | 1 190              | 985    | 121      | 100    | <b>KLM20S</b>   | 6                   | 0.10              |
|                                                                  | <b>32</b>                                                        | <b>42</b>                                                        | 30.3                 | 1.6   | 30.5  | —     | 8.6  | 50° | —        | 1 190              | 985    | 121      | 100    | <b>KLM20P</b>   | 5                   | 0.085             |
| <b>25</b><br>$\begin{smallmatrix} 0 \\ -0.010 \end{smallmatrix}$ | <b>40</b>                                                        | <b>59</b>                                                        | 40.7                 | 1.85  | 38    | —     | —    | —   | —        | 2 640              | 2 340  | 269      | 239    | <b>KLM25</b>    | 6                   | 0.22              |
|                                                                  | <b>40</b><br>$\begin{smallmatrix} 0 \\ -0.014 \end{smallmatrix}$ | <b>59</b><br>$\begin{smallmatrix} 0 \\ -0.120 \end{smallmatrix}$ | 40.7                 | 1.85  | 38    | 0.6   | —    | —   | —        | 2 640              | 2 340  | 269      | 239    | <b>KLM25S</b>   | 6                   | 0.22              |
|                                                                  | <b>40</b>                                                        | <b>59</b>                                                        | 40.7                 | 1.85  | 38    | —     | 10.8 | 50° | —        | 2 640              | 2 340  | 269      | 239    | <b>KLM25P</b>   | 5                   | 0.19              |
| <b>30</b><br>$\begin{smallmatrix} 0 \\ -0.010 \end{smallmatrix}$ | <b>45</b>                                                        | <b>64</b>                                                        | 44.2                 | 1.85  | 43    | —     | —    | —   | —        | 2 540              | 2 360  | 259      | 241    | <b>KLM30</b>    | 6                   | 0.26              |
|                                                                  | <b>45</b><br>$\begin{smallmatrix} 0 \\ -0.014 \end{smallmatrix}$ | <b>64</b><br>$\begin{smallmatrix} 0 \\ -0.120 \end{smallmatrix}$ | 44.2                 | 1.85  | 43    | 0.6   | —    | —   | —        | 2 540              | 2 360  | 259      | 241    | <b>KLM30S</b>   | 6                   | 0.26              |
|                                                                  | <b>45</b>                                                        | <b>64</b>                                                        | 44.2                 | 1.85  | 43    | —     | 13.0 | 50° | —        | 2 540              | 2 360  | 259      | 241    | <b>KLM30P</b>   | 5                   | 0.22              |
| <b>35</b><br>$\begin{smallmatrix} 0 \\ -0.012 \end{smallmatrix}$ | <b>52</b>                                                        | <b>70</b>                                                        | 49.2                 | 2.2   | 49    | —     | —    | —   | —        | 3 400              | 2 970  | 345      | 305    | <b>KLM35</b>    | 6                   | 0.40              |
|                                                                  | <b>52</b><br>$\begin{smallmatrix} 0 \\ -0.017 \end{smallmatrix}$ | <b>70</b><br>$\begin{smallmatrix} 0 \\ -0.120 \end{smallmatrix}$ | 49.2                 | 2.2   | 49    | 1.2   | —    | —   | —        | 3 400              | 2 970  | 345      | 305    | <b>KLM35S</b>   | 6                   | 0.40              |
|                                                                  | <b>52</b>                                                        | <b>70</b>                                                        | 49.2                 | 2.2   | 49    | —     | 15.1 | 50° | —        | 3 400              | 2 970  | 345      | 305    | <b>KLM35P</b>   | 5                   | 0.34              |



Type KLM  
(Standard type)



Type KLM··S  
(Clearance-adjustable type)



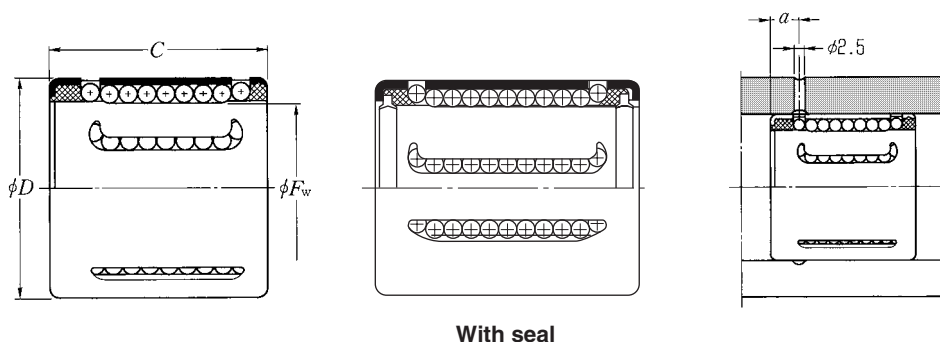
Type KLM··P  
(Open type)

$F_w$  40mm

| Boundary dimensions   |                       |                       |             |       |       |     |      |          | Basic load ratings |          |         |          | Bearing numbers | Number of ball rows | Mass kg<br>(approx.) |
|-----------------------|-----------------------|-----------------------|-------------|-------|-------|-----|------|----------|--------------------|----------|---------|----------|-----------------|---------------------|----------------------|
| $F_w$                 | $D$                   | $C$                   | mm          |       | $D_1$ | $g$ | $h$  | $\theta$ | dynamic            | static   | dynamic | static   |                 |                     |                      |
|                       |                       |                       | $C_1$       | $C_2$ |       |     |      |          | N                  |          | kgf     |          |                 |                     |                      |
|                       |                       |                       | $\pm 0.300$ |       |       |     |      |          | $C_r$              | $C_{or}$ | $C_r$   | $C_{or}$ |                 |                     |                      |
| 40<br>$0$<br>$-0.012$ | 60<br>$0$<br>$-0.017$ | 80<br>$0$<br>$-0.120$ | 60.3        | 2.1   | 57    | —   | —    | —        | 3 950              | 3 750    | 400     | 385      | KLM40           | 6                   | 0.62                 |
|                       | 60<br>$0$<br>$-0.017$ | 80<br>$0$<br>$-0.120$ | 60.3        | 2.1   | 57    | 1.2 | —    | —        | 3 950              | 3 750    | 400     | 385      | KLM40S          | 6                   | 0.62                 |
|                       | 60<br>$0$<br>$-0.017$ | 80<br>$0$<br>$-0.120$ | 60.3        | 2.1   | 57    | —   | 17.2 | 50°      | 3 950              | 3 750    | 400     | 385      | KLM40P          | 5                   | 0.53                 |

## Type KH

## Type KH··LL



With seal

 $F_w$  6~50mm

| Boundary dimensions |          |       |          | Bearing numbers      | Basic load ratings |        |         |        | Number of ball rows | Mass<br>kg<br>(approx.) |
|---------------------|----------|-------|----------|----------------------|--------------------|--------|---------|--------|---------------------|-------------------------|
| mm                  |          |       |          |                      | dynamic            | static | dynamic | static |                     |                         |
| $F_w$               | $D$      | $C$   | $a^{1)}$ |                      | N                  |        | kgf     |        |                     |                         |
| $C_r$               | $C_{or}$ | $C_r$ | $C_{or}$ |                      |                    |        |         |        |                     |                         |
| 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             | 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             | 775                | 600    | 79      | 61     | 5                   | 0.027                   |
| 20                  | 28       | 30    | 7        | KH2030               | 1 050              | 880    | 107     | 90     | 6                   | 0.033                   |
|                     | 28       | 30    | 7        | KH2030LL             | 1 050              | 880    | 107     | 90     | 6                   | 0.033                   |
| 25                  | 35       | 40    | 8        | KH2540               | 1 930              | 1 560  | 197     | 159    | 6                   | 0.066                   |
|                     | 35       | 40    | 8        | KH2540LL             | 1 930              | 1 560  | 197     | 159    | 6                   | 0.066                   |
| 30                  | 40       | 50    | 8        | KH3050               | 2 700              | 2 450  | 275     | 250    | 7                   | 0.095                   |
|                     | 40       | 50    | 8        | KH3050LL             | 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.

## 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 clearance

Any linear ball bearings must be used with radial clearance as less as possible. Particularly where linear ball bearing is applied to a vertical shaft or high accuracy is required, it is desirable to select and combine appropriate bearing and shaft for securing radial clearance in the range of 0 to  $-10 \mu\text{m}$  (by preloading).

**Table 2** shows the bearing fits on shaft and in housing.

**Table 2** Bearing fits

| Operating conditions                          | Shaft                | Housing |
|-----------------------------------------------|----------------------|---------|
| Usual operating conditions                    | k5 (m5)              | H6 (H7) |
| Vertical shaft and high accuracy applications | n5 (p5) <sup>①</sup> | J6 (J7) |

① 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

| 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**)

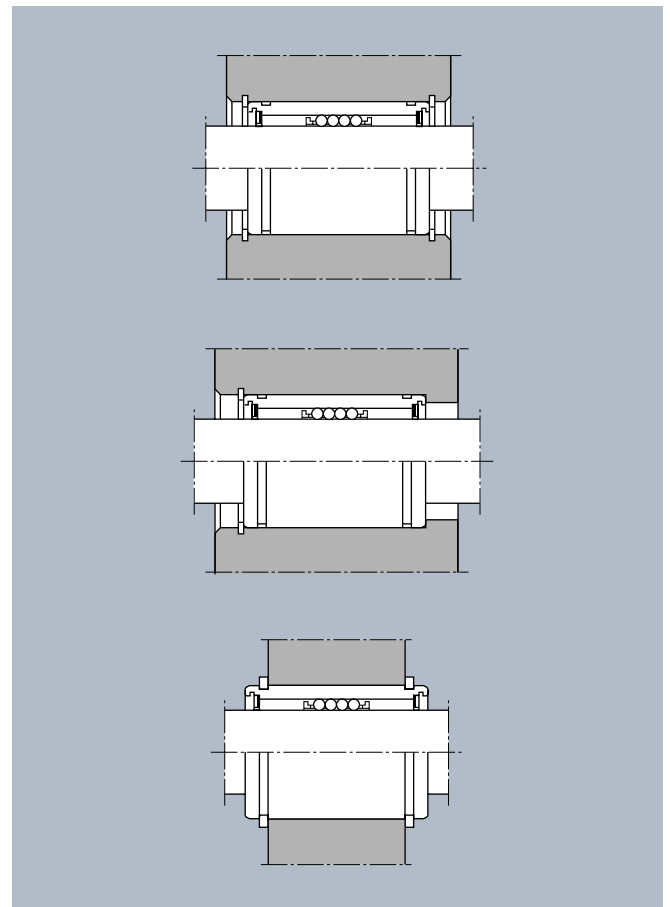


**Fig. 1** Axial fixing of bearing

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**)

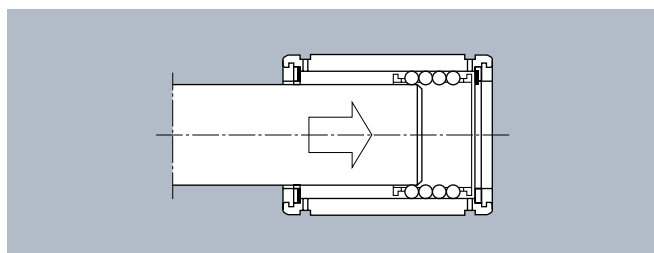


Fig. 2

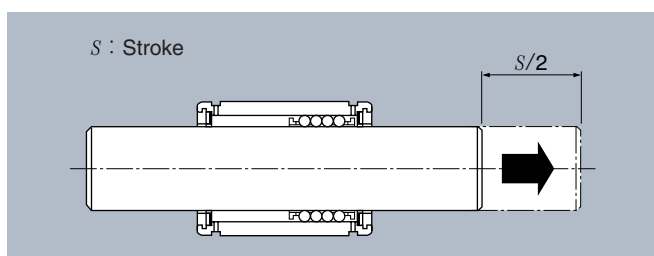


Fig. 3

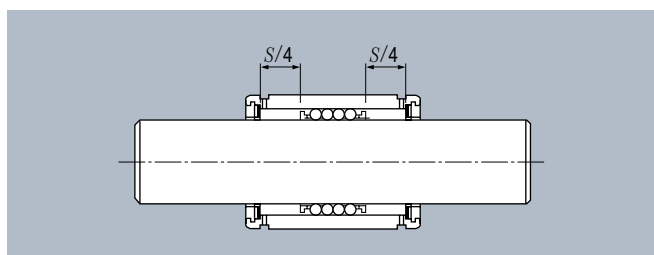


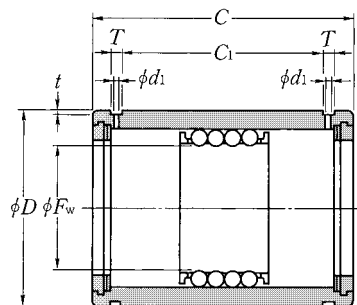
Fig. 4

The outer ring must be press-fitted so its grease feed hole locates at load non-acting side.

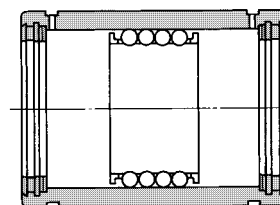
Where moment load acts on a bearing due to use of a vertical shaft, the load could act on the grease feed hole. Caution it.

# Type KD

## Type KD··LL



**Type KD**  
**(Open type)**



**Type KD··LL**  
**(With seal)**

$F_w$  10~80mm

| Boundary dimensions<br>mm |           |          |     |     |       |       |                           |       |                               |  | Bearing numbers |              | Basic load ratings |        |                |        | Mass<br>(approx.)<br>kg |                |
|---------------------------|-----------|----------|-----|-----|-------|-------|---------------------------|-------|-------------------------------|--|-----------------|--------------|--------------------|--------|----------------|--------|-------------------------|----------------|
| $F_w$<br>F6               | $D$<br>h5 | $C^{1)}$ | $T$ | $t$ | $d_1$ | $C_1$ | Type KD<br>Max.<br>stroke | $C_1$ | Type KD··LL<br>Max.<br>stroke |  | Type KD         | Type KD··LL  | dynamic<br>N       | static | dynamic<br>kgf | static | Type<br>KD              | Type<br>KD··LL |
| 10                        | 19        | 30       | 1.7 | 0.4 | 1.5   | 22.7  | 27                        | 15.5  | 19                            |  | KD101930        | KD101930LL   | 725                | 535    | 74             | 55     | 0.028                   | 0.030          |
| 12                        | 23        | 32       | 1.7 | 0.4 | 1.5   | 24.5  | 30                        | 17.1  | 22                            |  | KD122332        | KD122332LL   | 925                | 725    | 94             | 74     | 0.052                   | 0.055          |
| 16                        | 28        | 37       | 1.7 | 0.5 | 1.5   | 29.1  | 33                        | 21.1  | 26                            |  | KD162837        | KD162837LL   | 1 490              | 1 070  | 152            | 110    | 0.073                   | 0.078          |
| 20                        | 32        | 45       | 2.2 | 0.5 | 2     | 35.8  | 55                        | 26.8  | 46                            |  | KD203245        | KD203245LL   | 1 680              | 1 230  | 171            | 125    | 0.100                   | 0.105          |
| 25                        | 37        | 45       | 2.2 | 0.6 | 2     | 35.8  | 55                        | 26.8  | 46                            |  | KD253745        | KD253745LL   | 1 890              | 1 410  | 193            | 144    | 0.115                   | 0.120          |
| 30                        | 45        | 65       | 2.7 | 0.7 | 2.5   | 53.5  | 81                        | 45.1  | 73                            |  | KD304565        | KD304565LL   | 3 850              | 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   | 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   | 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   | 6 450              | 5 300  | 655            | 540    | 0.675                   | 0.680          |
| 50                        | 72        | 100      | 3.2 | 1   | 3     | 86.4  | 136                       | 77.4  | 125                           |  | KD5072100       | KD5072100LL  | 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  | 9 250              | 7 550  | 945            | 770    | 1.34                    | 1.36           |
| 60                        | 85        | 100      | 3.2 | 1   | 3     | 86.4  | 136                       | 77.4  | 122                           |  | KD6085100       | KD6085100LL  | 9 900              | 8 250  | 1 010          | 845    | 1.41                    | 1.43           |
| 70                        | 95        | 100      | 3.2 | 1   | 3     | 86.4  | 136                       | 77.4  | 122                           |  | KD7095100       | KD7095100LL  | 10 600             | 9 000  | 1 090          | 920    | 1.61                    | 1.63           |
| 80                        | 110       | 100      | 3.2 | 1.2 | 3     | 86    | 129                       | 77    | 116                           |  | KD80110100      | KD80110100LL | 13 300             | 10 900 | 1 360          | 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**

| Characteristics                      | Tolerance          |
|--------------------------------------|--------------------|
| Surface roughness (max)              | 0.2a               |
| Surface hardness ①                   | HRC58~64           |
| Effective hardened layer depth (min) | 0.4mm              |
| Mounting accuracy (max) ②            | 0.1 mm per 1000 mm |

① Where raceway surface hardening not allowed, a quenched spring plate may be used.

② Mounting accuracy is expressed with an inclination value in **Fig. 1**.

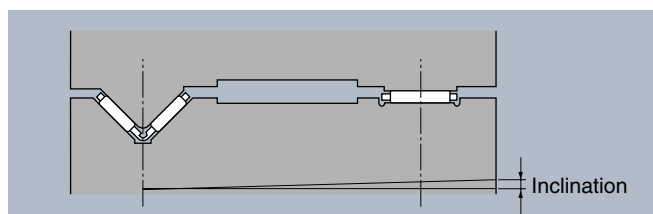


**Fig. 1**

### 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**)

$$L = S/2 + L_1 \quad \dots\dots\dots (1)$$

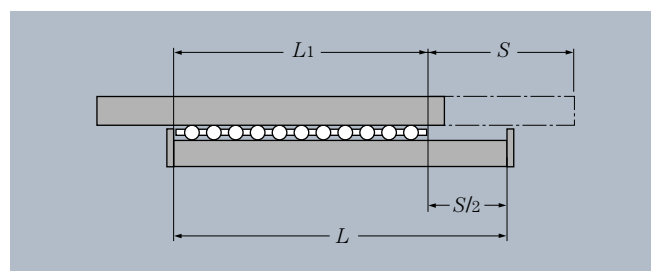


**Fig. 2**

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 over-run of the flat roller bearing. (**Fig. 5**)

**Figs. 3 and 4** illustrate application examples of the linear flat roller bearing unit.

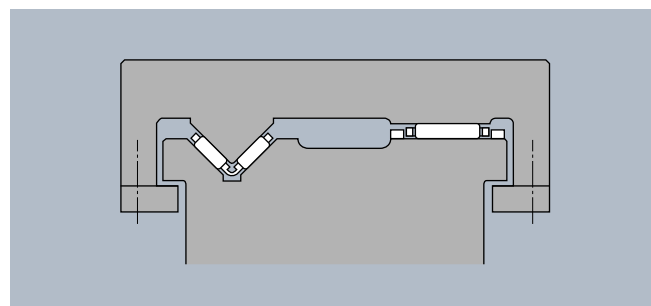


**Fig. 3 General application**

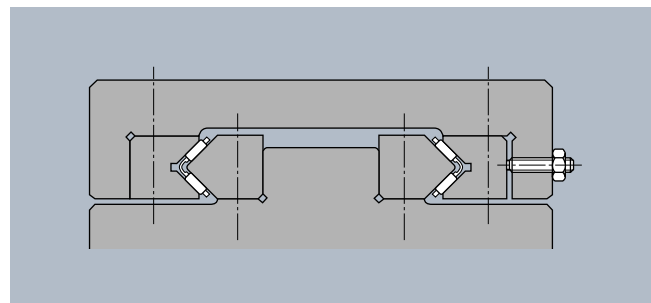


**Fig. 4 When overhung load acts on**

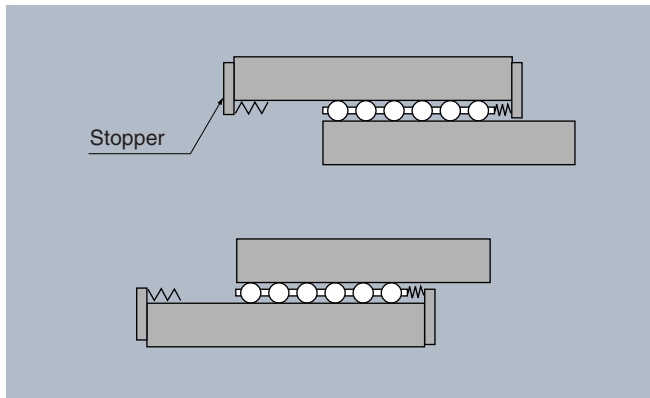
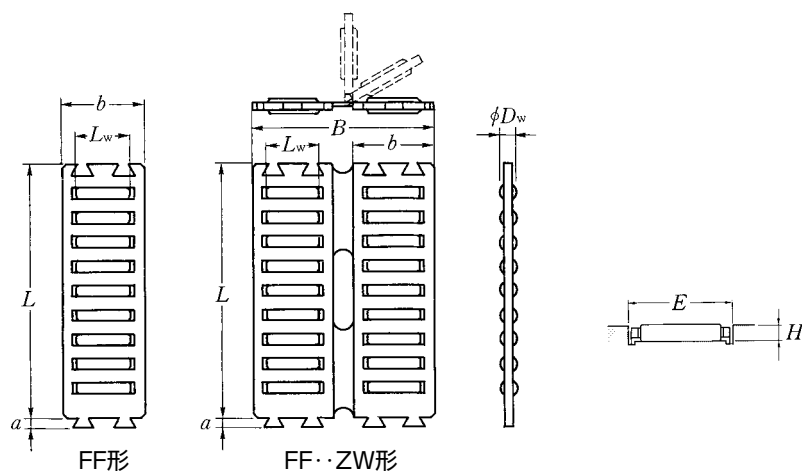


Fig. 5

## Type FF

## Type FF··ZW



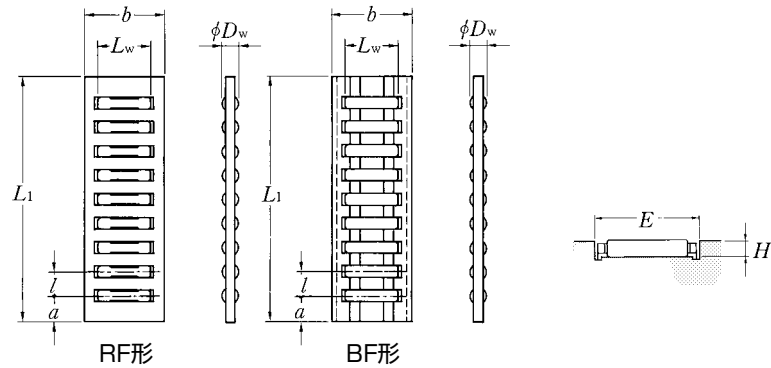
$D_w$  2~3.5mm

| Boundary dimensions |     |     |     |       |     | dynamic<br>N | Basic load ratings |          |        |          | Bearing<br>numbers | Number<br>of<br>rolls      | Abutment<br>dimensions    |        | Mass<br><br>kg<br><br>(approx.) |
|---------------------|-----|-----|-----|-------|-----|--------------|--------------------|----------|--------|----------|--------------------|----------------------------|---------------------------|--------|---------------------------------|
| mm                  |     |     |     |       |     |              | static             | dynamic  | static | dynamic  |                    |                            | mm                        |        |                                 |
| $D_w^{1)}$          | $b$ | $B$ | $L$ | $L_w$ | $a$ |              | $C_r$              | $C_{or}$ | $C_r$  | $C_{or}$ |                    |                            | $E$                       | $H$    |                                 |
| 2                   | 10  | —   | 32  | 6.8   | 2   | 8 500        | 19 700             | 865      | 2 010  | FF2010   | 7                  | 10.3 <sup>+0.1<br/>0</sup> | 1.7 <sup>0<br/>-0.2</sup> | 0.0020 |                                 |
| 2                   | 10  | 25  | 32  | 6.8   | 2   | 15 500       | 39 500             | 1 580    | 4 000  | FF2025ZW | 14                 | 25.3 <sup>+0.1<br/>0</sup> | 1.7 <sup>0<br/>-0.2</sup> | 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<br/>0</sup> | 2.2 <sup>0<br/>-0.2</sup> | 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<br/>0</sup> | 2.2 <sup>0<br/>-0.2</sup> | 0.0082 |                                 |
| 3                   | 20  | —   | 60  | 13.8  | 3   | 31 000       | 79 500             | 3 150    | 8 100  | FF3020   | 9                  | 20.4 <sup>+0.1<br/>0</sup> | 2.7 <sup>0<br/>-0.2</sup> | 0.0089 |                                 |
| 3                   | 20  | 45  | 60  | 13.8  | 3   | 53 500       | 145 000            | 5 450    | 14 800 | FF3045ZW | 18                 | 45.4 <sup>+0.1<br/>0</sup> | 2.7 <sup>0<br/>-0.2</sup> | 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<br/>0</sup> | 3.2 <sup>0<br/>-0.2</sup> | 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<br/>0</sup> | 3.2 <sup>0<br/>-0.2</sup> | 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> |
|---------------------|-----|------------|-------|-----|------|----------------------------------|----------|---------|----------|-----------------|----------------------------|---------------------------|--------------------|
|                     |     |            |       |     |      | dynamic                          | static   | dynamic | static   |                 | mm                         |                           | kg                 |
| mm                  |     |            |       |     |      | N                                |          | kgf     |          |                 |                            |                           |                    |
| $D_w^{1)}$          | $b$ | $L_1^{2)}$ | $L_w$ | $l$ | $a$  | $C_r$                            | $C_{or}$ | $C_r$   | $C_{or}$ |                 | $E$                        | $H$                       | (approx.)          |
| 3                   | 20  | 705        | 13.8  | 6   | 4.5  | 34 000                           | 88 500   | 3 450   | 9 000    | RF3020/705      | 20.4 <sup>+0.1<br/>0</sup> | 2.7 <sup>0<br/>-0.2</sup> | 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<br/>0</sup> | 2.7 <sup>0<br/>-0.2</sup> | 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<br/>0</sup> | 4.7 <sup>0<br/>-0.2</sup> | 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<br/>0</sup> | 4.7 <sup>0<br/>-0.2</sup> | 0.073              |
| 7                   | 28  | 1 000      | 24    | 11  | 10.5 | 155 000                          | 355 000  | 15 800  | 36 000   | BF7028/1000     | 28.5 <sup>+0.1<br/>0</sup> | 6.7 <sup>0<br/>-0.2</sup> | 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<br/>0</sup> | 6.7 <sup>0<br/>-0.2</sup> | 0.110              |

Note 1) The dimensional tolerance for needle roller diameter  $D_w$  is 0 to  $-2 \mu\text{m}$ .

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.

$$C = f_1^{7/9} \cdot C_r$$

$$C_0 = f_1 \cdot C_{0r}$$

$$\text{Herein, } f_1 = 0.1 (L_1 + l - 2a) / l$$

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.

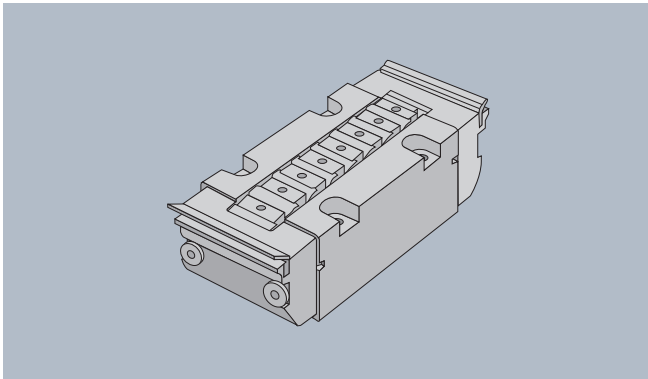


Fig. 1

### 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

| 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                          |

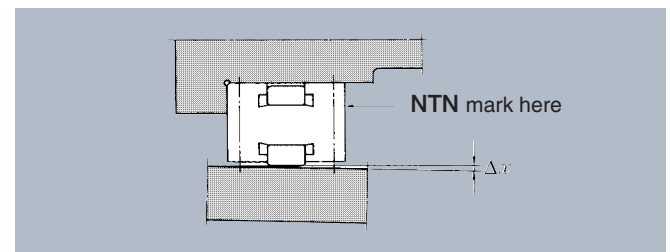


Fig. 2

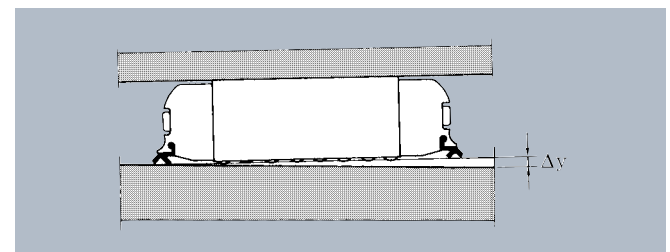


Fig. 3

### How to mount

Fix linear roller bearing using the tapped holes which are provided on the mounting reference surface. (See Fig. 4)

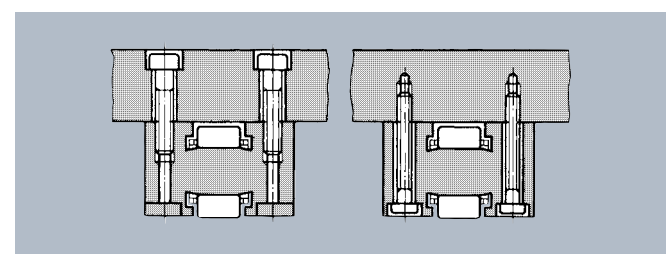
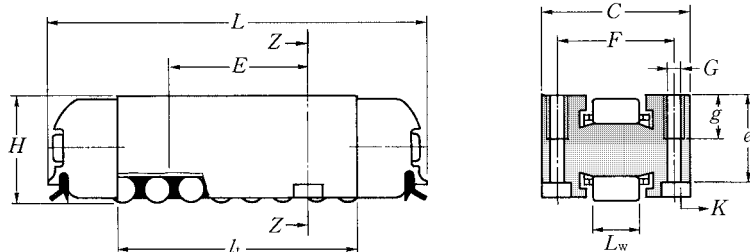


Fig. 4

## Type RLM



Section Z-Z

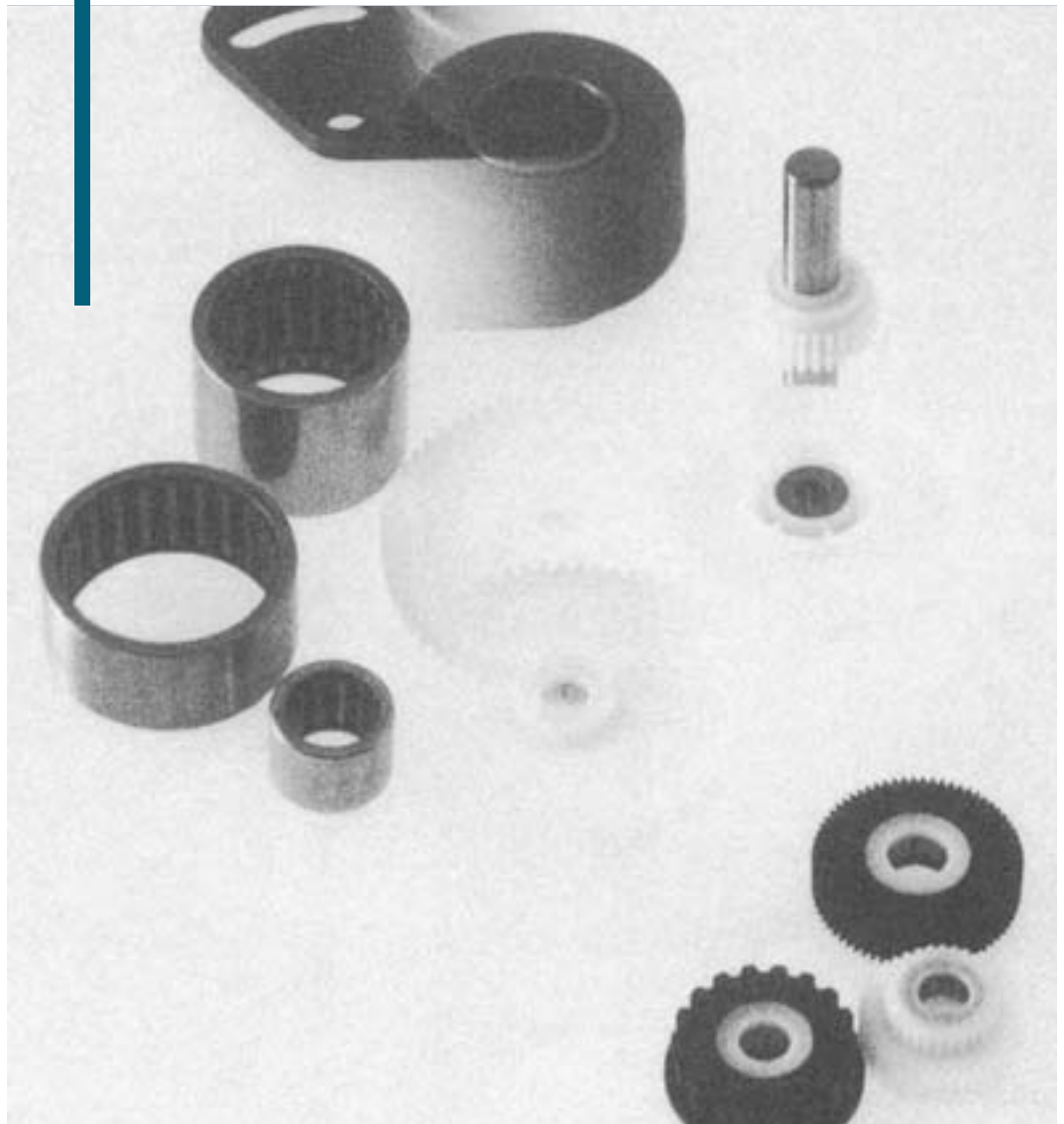
$H$  16~38mm

| Boundary dimensions  |                       |                      |                       |          |          |          |                      |          |          |          | Bearing numbers | Basic load ratings |         |         |        | Required case depth on track<br>(min.)<br>mm | Mass<br>kg<br>(approx.) |
|----------------------|-----------------------|----------------------|-----------------------|----------|----------|----------|----------------------|----------|----------|----------|-----------------|--------------------|---------|---------|--------|----------------------------------------------|-------------------------|
| mm                   |                       |                      |                       |          |          |          |                      |          |          |          |                 | dynamic            | static  | dynamic | static |                                              |                         |
| <i>H</i>             | <i>C</i>              | <i>L</i>             | <i>L<sub>w</sub></i>  | <i>E</i> | <i>F</i> | <i>G</i> | <i>L<sub>t</sub></i> | <i>e</i> | <i>g</i> | <i>K</i> |                 | N                  | kgf     |         |        |                                              |                         |
| <i>C<sub>r</sub></i> | <i>C<sub>or</sub></i> | <i>C<sub>r</sub></i> | <i>C<sub>or</sub></i> |          |          |          |                      |          |          |          |                 |                    |         |         |        |                                              |                         |
| 16                   | 25                    | 62                   | 8                     | 17       | 19       | M4       | 35.5                 | 12.5     | 6        | φ 3.2    | RLM16× 62       | 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    | RLM19× 69       | 26 100             | 58 000  | 2 670   | 5 900  | 0.3                                          | 0.16                    |
| 26                   | 40                    | 86                   | 14                    | 28       | 30       | M6       | 52.4                 | 21       | 10       | φ 4.5    | RLM26× 86       | 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    | RLM26×102       | 62 500             | 142 000 | 6 400   | 14 500 | 0.4                                          | 0.53                    |
| 26                   | 40                    | 126                  | 14                    | 68       | 30       | M6       | 91.8                 | 21       | 10       | φ 4.5    | RLM26×126       | 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    | RLM38×134       | 124 000            | 270 000 | 12 700  | 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 is going to rotate counterclockwise against shaft rotation (arrow → direction on outer ring widthway surface), the rollers advance to the position of engagement with the outer ring cam face by spring action and drive the shaft by acting as a wedge between the outer ring cam face and 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)

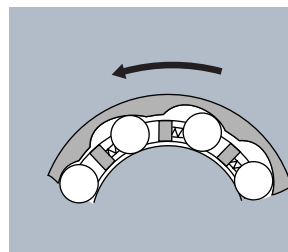


Fig. 1  
One-way clutch in engagement

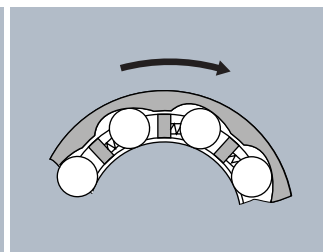
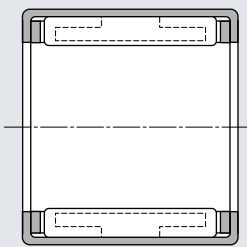
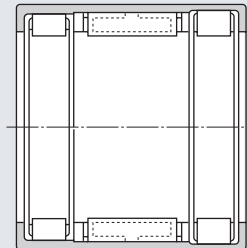


Fig. 2  
One-way clutch in idling

| Type                                                                                                   | Applied shaft diameter (mm) | Composition of nominal clutch number                                      | Remarks                                                                                                                                                                                                                                                                                                    |
|--------------------------------------------------------------------------------------------------------|-----------------------------|---------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Type HF</b><br>   | $\phi 6 \sim \phi 35$       | <b>HF 10 12</b><br>————— Width<br>————— Bore diameter<br>————— 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.<br><b>This one-way clutch must be provided with a bearing at its both sides to support radial load acting thereon and to ensure smooth rotating motion.</b>                |
| <b>Type HFL</b><br> | $\phi 8 \sim \phi 35$       | <b>HFL 10 22</b><br>————— Width<br>————— Bore diameter<br>————— 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**

| Type | Shaft   | Housing     |                   |
|------|---------|-------------|-------------------|
|      |         | Iron series | Light metal alloy |
| HF   | h5 (h6) | N6 (N7)     | R6 (R7)           |
| HFL  |         |             |                   |

**Table 2 Recommended housing wall thickness**

| Housing material  | Housing wall thickness      |
|-------------------|-----------------------------|
| Steel, cast iron  | 0.75 ( $D - F_w$ ) and over |
| Light metal alloy | 1.5 ( $D - F_w$ ) and over  |

## 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.

## Allowable operating temperature

For Type HF and HFL...Oil lubrication : -10 to 120°C  
Grease lubrication : -10 to 70°C

However, consult with NTN for application under temperature exceeding the said temperature range.

## 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.

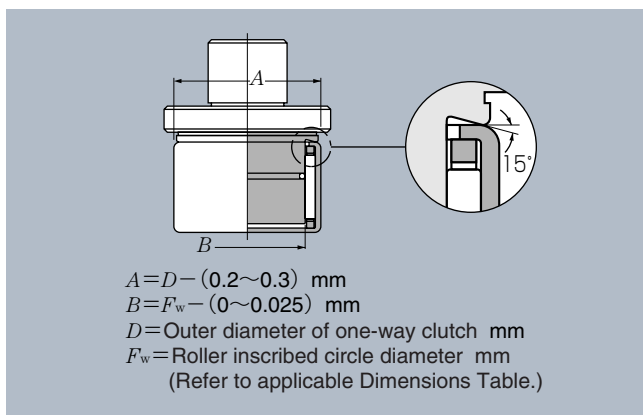


Fig. 3

## Precautions in selecting

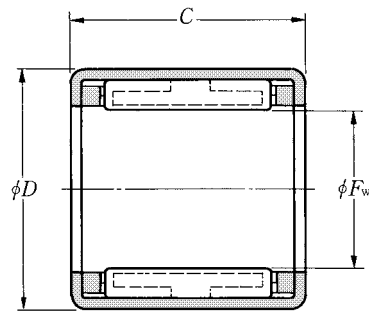
NTN makes it a rule to conduct functional verification tests on its manufactured one-way clutches under various test conditions. However, be noted that the clutch lifetime could reduce depending on the following factors; application to high load torque, high oscillation cycle and fine oscillation, etc., large radial load acting on one-way clutch unit, and use of a shaft with lower hardness.

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.

**When it is forecast that clutching function failure of one-way clutch(ex. clutch slip in engaging) could result in serious damage to person or equipment, appropriate safety devices must be provided separately.**

## Type HF



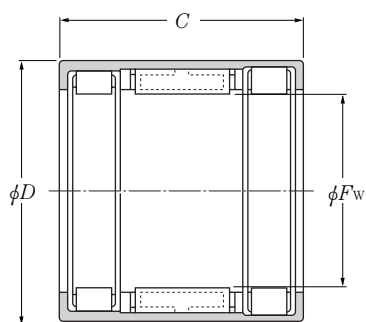
Type HF

 $F_w$  6~35mm

| Boundary dimensions |           |                   | Torque capacity |       | Bearing numbers | Mass<br>kg<br>(approx.) | Part number by radial load            |                          |
|---------------------|-----------|-------------------|-----------------|-------|-----------------|-------------------------|---------------------------------------|--------------------------|
| $F_w$               | mm<br>$D$ | $C$<br>0<br>-0.25 | N·m             | kgf·m |                 |                         | (approx.)<br>needle roller<br>bearing | oil retaining<br>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.<br>mm<br>$d$ | Boundary dimensions |           |                   | Basic load ratings    |                         |                         |                           | Bearing numbers | Torque capacity |       | Mass<br>kg<br>(approx.) |
|-------------------------|---------------------|-----------|-------------------|-----------------------|-------------------------|-------------------------|---------------------------|-----------------|-----------------|-------|-------------------------|
|                         | $F_w$               | mm<br>$D$ | $C$<br>0<br>-0.25 | dynamic<br>N<br>$C_r$ | static<br>N<br>$C_{or}$ | dynamic<br>kgf<br>$C_r$ | static<br>kgf<br>$C_{or}$ |                 | 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 bottom roller bearings for textile machinery are grease-prefilled needle roller bearings intended to support the bottom rollers (fluted rollers) of a fine spinning machine, a roving frame or a drawing frame. **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 (bearing number + tail code **SA**) wherein inner ring and outer ring are separable from one another according to saddle type and another bearing type (bearing number + tail code **SB**) wherein inner ring and outer ring are non-separable. Of course, these bearings can also be supplied without saddle.

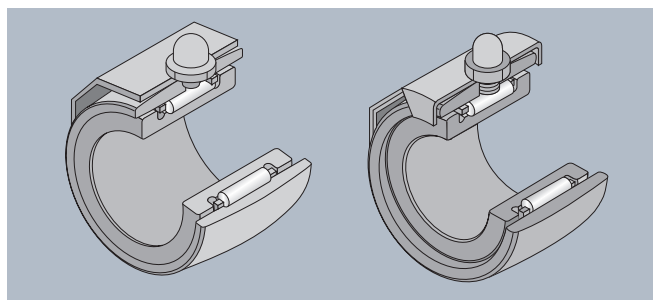


Fig. 1 Type FRIS · SA

Fig. 2 Type FRIS · SB

On the other hand, **B-series** bearings are further classified into bearing type with grease nipple (bearing number + tail code **N**), bearing type with knock pin on its outer ring (bearing number + tail code **P**) and bearing type with knock hole on its outer ring (bearing number +

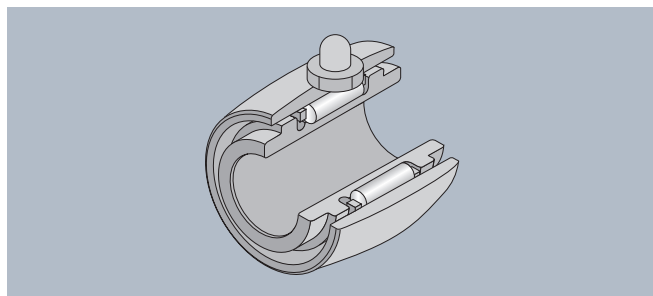


Fig. 3 Type FRIS

**W**) (latter two types—classified by the fixing method applied).

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.

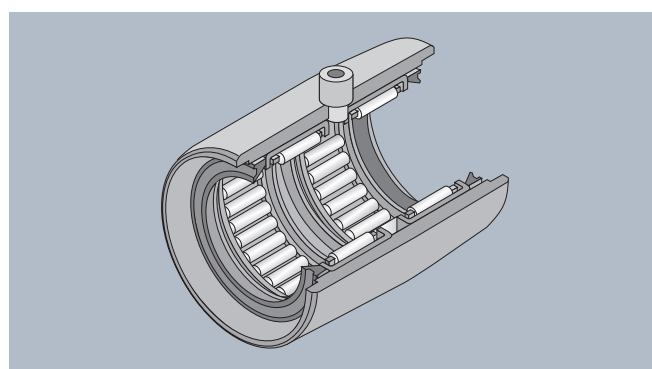


Fig. 4 Type FR

### Nominal bearing number

Nominal bearing number comprises type code, dimension code [shaft dia. ( $d$  or  $F_w$ )] and tail code.

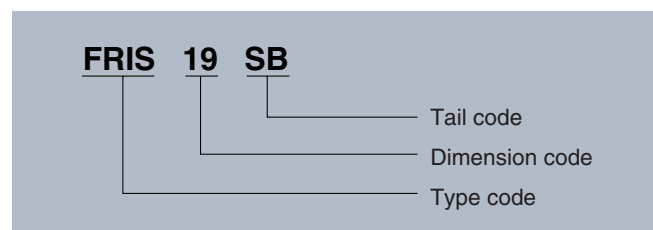


Fig. 5

### Bearing fits

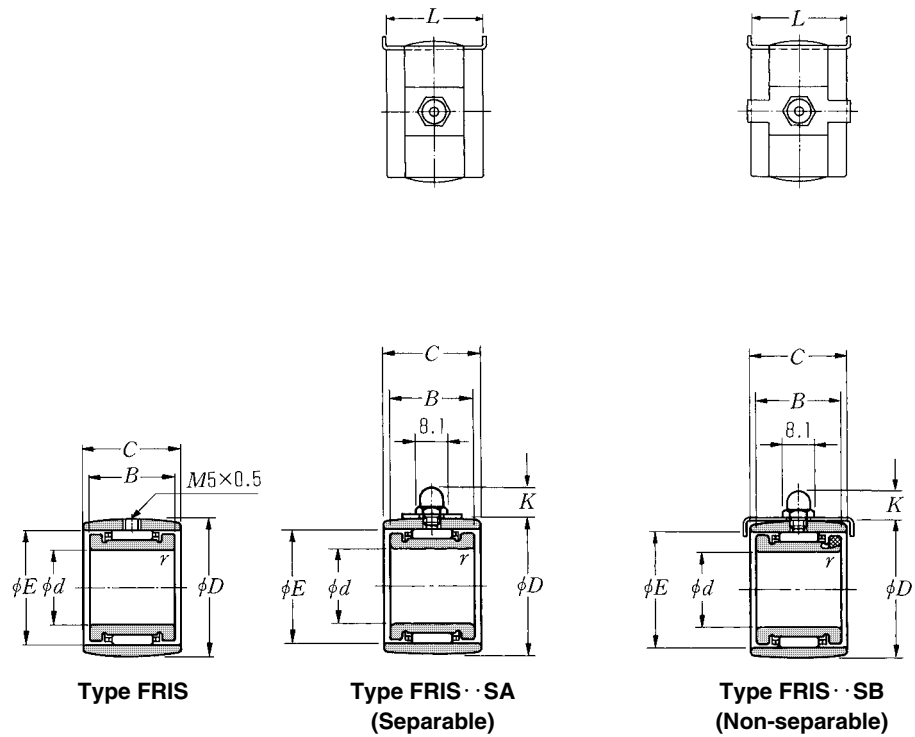
Table 1 shows bearing fits on/in shaft and housing.

Table 1 Bearing fits

| Bearing type | Shaft         |              | Housing (stand) |
|--------------|---------------|--------------|-----------------|
|              | Screwed joint | Spline joint |                 |
| FRIS         | g5 (g6)       | j5 (j6)      | H10             |
| FR           | h5 (h6)       |              | H10             |

## Type FRIS Series A

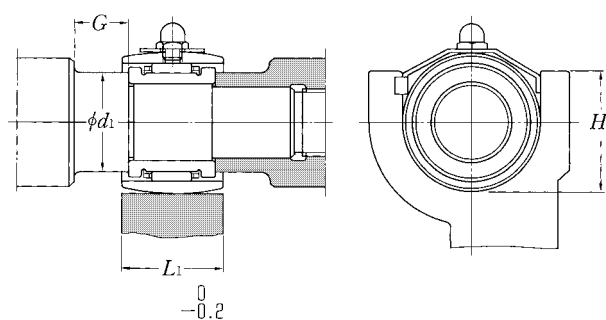
(For fine spinning machine/  
roving frame)



$d$  16.5~25mm

| Boundary dimensions |                                   |               |               |      |                          |      |      |  | Basic load ratings |        |                |        |
|---------------------|-----------------------------------|---------------|---------------|------|--------------------------|------|------|--|--------------------|--------|----------------|--------|
| $d$<br>-0.010       | $D$                               | $B$<br>-0.050 | $C$<br>-0.120 | $E$  | $r$ 's min <sup>1)</sup> | $L$  | $K$  |  | dynamic<br>N       | static | dynamic<br>kgf | static |
| 16.5                | 28 <sup>0</sup> <sub>-0.020</sub> | 19            | 22            | 23.5 | 0.3                      | 22.2 | 7.7  |  | 10 200             | 14 600 | 1 040          | 1 480  |
| 19                  | 32 <sup>0</sup> <sub>-0.025</sub> | 20            | 23            | 27   | 0.3                      | 22.2 | 7.7  |  | 11 800             | 18 500 | 1 200          | 1 880  |
|                     | 36                                | 22            | 25            | 29   | 0.3                      | 22.2 | 9.8  |  | 12 700             | 17 600 | 1 300          | 1 800  |
| 22                  | 42 <sup>0</sup> <sub>-0.025</sub> | 25            | 29            | 35   | 0.3                      | 26.4 | 10.2 |  | 19 500             | 25 300 | 1 980          | 2 580  |
| 25                  | 45 <sup>0</sup> <sub>-0.025</sub> | 25            | 29            | 37   | 0.3                      | 26.4 | 10.2 |  | 21 300             | 29 100 | 2 170          | 2 970  |

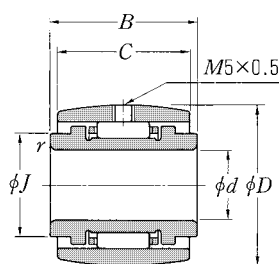
Note 1) Allowable minimum chamfer dimension  $r$ .



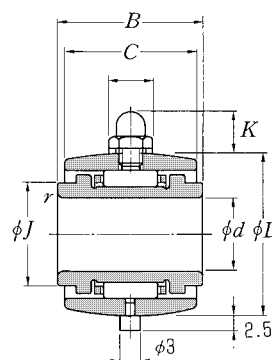
| Bearing numbers |                     |            | Abutment dimensions |       |     |       | Mass                             |
|-----------------|---------------------|------------|---------------------|-------|-----|-------|----------------------------------|
| bearing         | bearing with saddle |            | mm                  |       |     |       | kg                               |
|                 | Type SA             | Type SB    | $L_1$               | $d_1$ | $G$ | $H$   | bearing with saddle<br>(approx.) |
| 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>

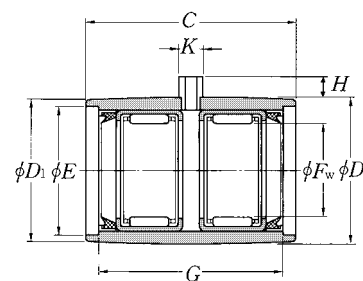
$d$  15~25mm

| Boundary dimensions |        |                          |                    |     |                 |     |              | Basic load ratings |         |          |           | Bearing numbers |                                      | Mass  |
|---------------------|--------|--------------------------|--------------------|-----|-----------------|-----|--------------|--------------------|---------|----------|-----------|-----------------|--------------------------------------|-------|
| $d$<br>0<br>-0.010  | $D$    | mm<br>$B$<br>0<br>-0.050 | $C$<br>0<br>-0.120 | $J$ | $r_s \min^{1)}$ | $K$ | dynamic<br>N | static             | dynamic | static   |           |                 | (approx.)<br>kg<br>Type<br>FRIS · NP |       |
|                     |        |                          |                    |     |                 |     | $C_r$        | $C_{or}$           | $C_r$   | $C_{or}$ | Type FRIS | Type FRIS · NP  |                                      |       |
| 15                  | 28     | 0<br>-0.020              | 24                 | 22  | 22              | 0.3 | 7.7          | 10 200             | 14 600  | 1 040    | 1 480     | FRIS15          | FRIS15NP                             | 0.070 |
| 15.875              | 30     | 0<br>-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<br>-0.020              | 26                 | 22  | 22              | 0.3 | 7.7          | 10 200             | 14 600  | 1 040    | 1 480     | FRIS16          | FRIS16NP                             | 0.083 |
|                     | 30     |                          | 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<br>-0.025              | 24                 | 23  | 24              | 0.3 | 7.7          | 11 800             | 18 500  | 1 200    | 1 880     | FRIS18          | FRIS18NP                             | 0.083 |
|                     | 32     |                          | 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<br>-0.025              | 23.81              | 23  | 24              | 0.3 | 7.7          | 11 800             | 18 500  | 1 200    | 1 880     | FRIS19.05       | FRIS19.05NP                          | 0.078 |
|                     | 34     |                          | 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     |                          | 24                 | 23  | 26              | 0.3 | 7.7          | 12 700             | 17 600  | 1 300    | 1 800     | FRIS20-2        | FRIS20-2NP                           | 0.089 |
|                     | 34     | 0<br>-0.025              | 26                 | 23  | 26              | 0.3 | 7.7          | 12 700             | 17 600  | 1 300    | 1 800     | FRIS20-4        | FRIS20-4NP                           | 0.097 |
|                     | 36     |                          | 26                 | 23  | 26              | 0.3 | 7.1          | 12 700             | 17 600  | 1 300    | 1 800     | FRIS20-7        | FRIS20-7NP                           | 0.125 |
| 22                  | 40     | 0<br>-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<br>-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<br>-0.025              | 26                 | 24  | 32              | 0.6 | 7.1          | 16 000             | 22 500  | 1 640    | 2 290     | FRIS25-1        | FRIS25-1NP                           | 0.154 |
|                     | 44     |                          | 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  $r$ .

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<br>kg<br>(approx.) |
|---------------------------------------|---------------------|-------------------|------|-------|------|------|-------|--------------------|--------|---------|--------|-------------------|-------------------------|
|                                       | mm                  |                   |      |       |      |      |       | dynamic            | static | dynamic | static |                   |                         |
|                                       | $D$<br>0<br>-0.050  | $C$<br>0<br>-0.20 | $E$  | $G$   | $H$  | $K$  | $D_1$ | N                  |        | kgf     |        |                   |                         |
| <b>17.462</b><br>$+0.053$<br>$+0.010$ | 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><br>$+0.053$<br>$+0.020$ | 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><br>$+0.053$<br>$+0.020$     | 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 prefilled 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 nominal number

Nominal number comprises type code (**JPU** · **S**), dimension code (Pulley outer dia. (*D*)) and tail code. Tension pulley with special-purposed holder is represented by nominal number + tail code (holder nominal number).

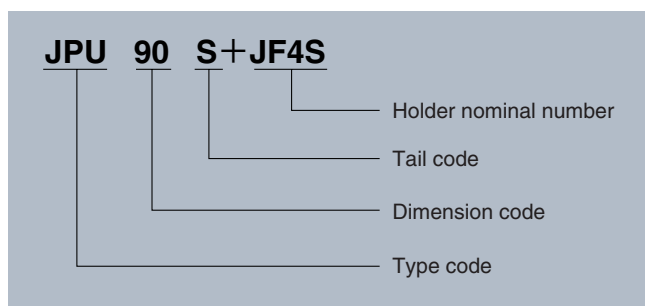


Fig. 4

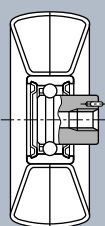


Fig. 1  
Single-row bearing type  
tension pulley

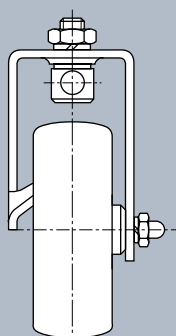


Fig. 2  
Tension pulley  
with holder

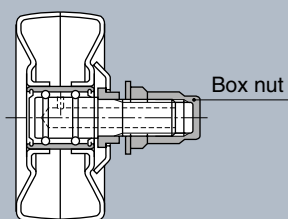
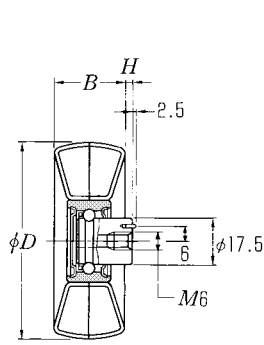
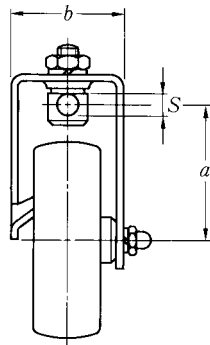


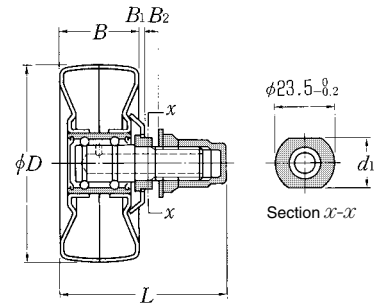
Fig. 3  
Double-row bearing type  
tension pulley



Example 1



Example 2



Example 3

$D$  60~100mm

| Boundary dimensions |     |       |     |                    |           |     |      |           |       | Bearing numbers | Sample number | Mass<br>kg<br>(approx.) |
|---------------------|-----|-------|-----|--------------------|-----------|-----|------|-----------|-------|-----------------|---------------|-------------------------|
| $D$                 | $B$ | $B_1$ | $H$ | $d_1$<br>0<br>-0.3 | mm<br>$a$ | $b$ | $S$  | $L$       | $B_2$ |                 |               |                         |
| 60                  | 25  | —     | 3.5 | —                  | —         | —   | —    | —         | —     | JPU60S          | 1             | 0.140                   |
| 70                  | 25  | —     | 3.5 | —                  | —         | —   | —    | —         | —     | JPU70S          | 1             | 0.160                   |
|                     | 25  | —     | 3.5 | —                  | 48        | 39  | 10.2 | —         | —     | JPU70S+JF1S     | 2             | 0.235                   |
|                     | 30  | 2     | —   | 21                 | —         | —   | —    | 67        | ~71   | 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<br>100 mm ball, load 3000 kgf |               |                       | Rockwell hardness <sup>2)</sup>               |                                                    |                                                 | Rockwell special hardness<br>special brake indenter |                              |                              | Shore hardness | Tensile strength<br>kgf/mm <sup>2</sup><br>Approx. value | Rockwell C scale hardness <sup>2)</sup> |
|-----------------------------------------|------------------------|------------------------------------------------|---------------|-----------------------|-----------------------------------------------|----------------------------------------------------|-------------------------------------------------|-----------------------------------------------------|------------------------------|------------------------------|----------------|----------------------------------------------------------|-----------------------------------------|
|                                         |                        | Standard ball                                  | Hultgren ball | Tungsten carbide ball | A scale<br>Load<br>60kgf<br>brale<br>indenter | B scale<br>Load<br>100 kgf dia.<br>1/16in.<br>ball | D-scale<br>Load<br>100 kgf<br>brale<br>indenter | 15-N scale<br>Load<br>15 kgfkgf                     | 30-N scale<br>Load<br>30 kgf | 45-N scale<br>load<br>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 "Conversion Tables" of JIS Z 8413 and Z 8438.

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

| Vickers hardness (DPH) | Brinell hardness<br>10 mm ball, load 3000 kgf |               |                       | Rockwell hardness <sup>2)</sup>                |                                                    |                                                 |                                                 | Rockwell special hardness<br>special brake indenter |                              |                              | Shore hardness | Tensile strength<br>kgf/mm <sup>2</sup><br>Approx. value | Vickers hardness<br>Load 50kgf |
|------------------------|-----------------------------------------------|---------------|-----------------------|------------------------------------------------|----------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-----------------------------------------------------|------------------------------|------------------------------|----------------|----------------------------------------------------------|--------------------------------|
|                        | Standard ball                                 | Hultgren ball | Tungsten carbide ball | A scale<br>Load<br>60 kgf<br>brale<br>indenter | B scale<br>Load<br>100 kgf dia.<br>1/16in.<br>ball | C-scale<br>Load<br>150 kgf<br>brale<br>indenter | D-scale<br>Load<br>100 kgf<br>brale<br>indenter | 15-N scale<br>Load<br>15 kgf                        | 30-N scale<br>Load<br>30 kgf | 45-N scale<br>load<br>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<br>10 mm ball, load 3000 kgf |               |                       | Rockwell hardness <sup>2)</sup>          |                                              |                                           |                                           | Rockwell special hardness<br>special brake indenter |                           |                           | Shore hardness | Tensile strength<br>kgf/mm <sup>2</sup><br>Approx. value | Vickers hardness<br>Load 50kgf |
|------------------------|-----------------------------------------------|---------------|-----------------------|------------------------------------------|----------------------------------------------|-------------------------------------------|-------------------------------------------|-----------------------------------------------------|---------------------------|---------------------------|----------------|----------------------------------------------------------|--------------------------------|
|                        | Standard ball                                 | Hultgren ball | Tungsten carbide ball | A scale<br>Load 60 kgf<br>brale indenter | B scale<br>Load 100 kgf dia.<br>1/16in. ball | C-scale<br>Load 150 kgf<br>brale indenter | D-scale<br>Load 100 kgf<br>brale indenter | 15-N scale<br>Load 15 kgf                           | 30-N scale<br>Load 30 kgf | 45-N scale<br>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                             |

1) Some of the parenthesized values in the above table are not used so frequently.

2) Approximate values were determined from "Conversion Tables" of JIS Z 8413 and Z 8438.

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<br>mm <sup>2</sup> /s | Saybolt<br>SUS (sec) | Redwood<br>R" (sec) | Engler<br>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<br>mm <sup>2</sup> /s | Saybolt<br>SUS (sec) | Redwood<br>R" (sec) | Engler<br>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 (Class-12)                | Medium class (Class-14)             | Coarse class (Class-16)             |
|------------------------------------------------------------|--------------------------------------|-------------------------------------|-------------------------------------|
| 0.5 and over 3 incl.<br>Over 3 6 incl.                     | $\pm 0.05$                           | $\pm 0.1$                           | —<br>$\pm 0.2$                      |
| Over 6 30 incl.<br>Over 30 120 incl.<br>Over 120 315 incl. | $\pm 0.1$<br>$\pm 0.15$<br>$\pm 0.2$ | $\pm 0.2$<br>$\pm 0.3$<br>$\pm 0.5$ | $\pm 0.5$<br>$\pm 0.8$<br>$\pm 1.2$ |
| Over 315 1000 incl.<br>Over 1000 2000 incl.                | $\pm 0.3$<br>$\pm 0.5$               | $\pm 0.8$<br>$\pm 1.2$              | $\pm 2$<br>$\pm 3$                  |

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

## Ordinary tolerances for castings

JIS B 0407

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 0407, Coarse class

Ordinary tolerance for length

Unit : mm

| Dimensional division \ Material Class | Gray castings |              | Spherical graphite castings |              |
|---------------------------------------|---------------|--------------|-----------------------------|--------------|
|                                       | Fine class    | Coarse class | Fine class                  | Coarse class |
| 120 incl.                             | $\pm 1$       | $\pm 1.5$    | $\pm 1.5$                   | $\pm 2$      |
| Over 120 250 incl.                    | $\pm 1.5$     | $\pm 2$      | $\pm 2$                     | $\pm 2.5$    |
| Over 250 400 incl.                    | $\pm 2$       | $\pm 3$      | $\pm 2.5$                   | $\pm 3.5$    |
| Over 400 800 incl.                    | $\pm 3$       | $\pm 4$      | $\pm 4$                     | $\pm 5$      |
| Over 800 1600 incl.                   | $\pm 4$       | $\pm 6$      | $\pm 5$                     | $\pm 7$      |
| Over 1600 3150 incl.                  | —             | $\pm 10$     | —                           | $\pm 10$     |

Ordinary tolerance for wall thickness

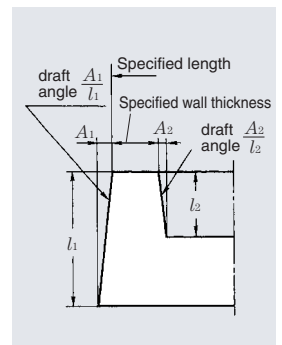
Unit : mm

| Dimensional division \ Material Class | Gray castings |              | Spherical graphite castings |              |
|---------------------------------------|---------------|--------------|-----------------------------|--------------|
|                                       | Fine class    | Coarse class | Fine class                  | Coarse class |
| 10 incl.                              | $\pm 1$       | $\pm 1.5$    | $\pm 1.2$                   | $\pm 2$      |
| Over 10 18 incl.                      | $\pm 1.5$     | $\pm 2$      | $\pm 1.5$                   | $\pm 2.5$    |
| Over 18 30 incl.                      | $\pm 2$       | $\pm 3$      | $\pm 2$                     | $\pm 3$      |
| Over 30 50 incl.                      | $\pm 2$       | $\pm 3.5$    | $\pm 2.5$                   | $\pm 4$      |

Dimension-A for draft angle

Unit : mm

| Dimensional division $l$ | 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  $l_1$  and  $l_2$  in the above sketch.  
A means  $A_1, A_2$  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, bending and drawing dimensions

Unit : mm

| Class<br>Dimensional division | Class-A | Class-B | Class-C | Class-D | Class-E |
|-------------------------------|---------|---------|---------|---------|---------|
| 30 incl.                      | ±0.1    | ±0.15   | ±0.25   | ±0.4    | ±0.6    |
| Over 30 120 incl.             | ±0.15   | ±0.25   | ±0.45   | ±0.7    | ±1.1    |
| Over 120 315 incl.            | ±0.2    | ±0.4    | ±0.6    | ±1      | ±1.6    |
| Over 315 1000 incl.           | ±0.3    | ±0.7    | ±1.1    | ±1.8    | ±2.8    |
| Over 1000 2000 incl.          | ±0.5    | ±1.1    | ±1.8    | ±3      | ±4.5    |

## Ordinary tolerance for bending angle

Unit : degree

| Class<br>Type of bending | Class B, C | Class D, E |
|--------------------------|------------|------------|
| Perpendicular bending    | ±1         | ±2         |
| Other bending            | ±1.5       | ±3         |

Remarks: The ordinary tolerance for bending angle shall be applied to Class-A tolerance.

## Ordinary tolerance for die casts

JIS B 0409

This Standard specifies the ordinary tolerance for the as-casted dimensions of zinc alloy die casts and aluminum alloy die casts.

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. Ex.: JIS B 0409

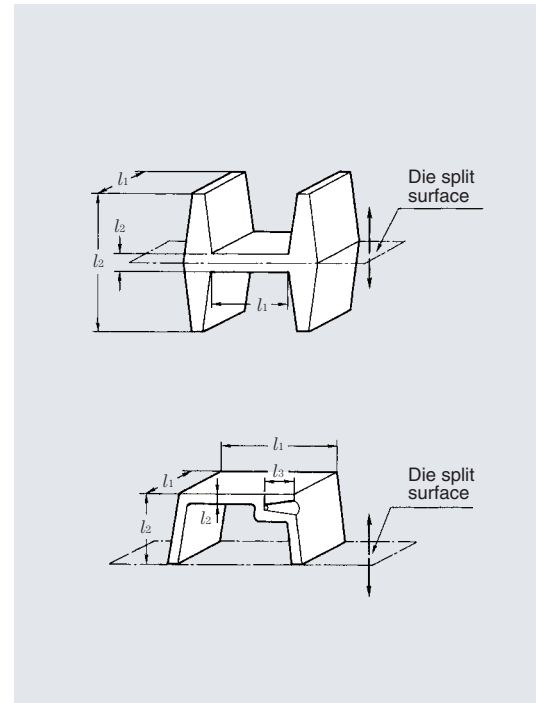
## Ordinary tolerance for dimensions

Unit : mm

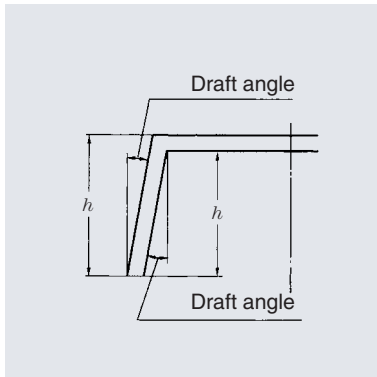
| Classification by application<br>Dimensional division | Portions casted by solid die and movable die |                                                                                    |                     | Portions casted by movable core                                                            |                    |
|-------------------------------------------------------|----------------------------------------------|------------------------------------------------------------------------------------|---------------------|--------------------------------------------------------------------------------------------|--------------------|
|                                                       | Parallel to die split surface                | Perpendicular to die split surface <sup>1)</sup> $l_2$                             |                     | $l_2$                                                                                      |                    |
|                                                       |                                              | Projected area of castings perpendicular to die split surface <sup>2)</sup> $cm^2$ |                     | Projected area of casting portion perpendicular to moving direction of movable core $cm^2$ |                    |
|                                                       |                                              | 600 and below                                                                      | over 600 2400 incl. | 150 and below                                                                              | over 150 600 incl. |
| 30 incl.                                              | ±0.25                                        | ±0.5                                                                               | ±0.6                | ±0.5                                                                                       | ±0.6               |
| Over 30 50 incl.                                      | ±0.3                                         | ±0.5                                                                               | ±0.6                | ±0.5                                                                                       | ±0.6               |
| Over 50 80 incl.                                      | ±0.35                                        | ±0.6                                                                               | ±0.6                | ±0.6                                                                                       | ±0.6               |
| Over 80 120 incl.                                     | ±0.45                                        | ±0.7                                                                               | ±0.7                | ±0.7                                                                                       | ±0.7               |
| Over 120 180 incl.                                    | ±0.5                                         | ±0.8                                                                               | ±0.8                | ±0.8                                                                                       | ±0.8               |
| Over 180 250 incl.                                    | ±0.55                                        | ±0.9                                                                               | ±0.9                | ±0.9                                                                                       | ±0.9               |
| Over 250 315 incl.                                    | ±0.6                                         | ±1                                                                                 | ±1                  | ±1                                                                                         | ±1                 |
| Over 315 400 incl.                                    | ±0.7                                         | —                                                                                  | —                   | —                                                                                          | —                  |
| Over 400 500 incl.                                    | ±0.8                                         | —                                                                                  | —                   | —                                                                                          | —                  |
| Over 500 630 incl.                                    | ±0.9                                         | —                                                                                  | —                   | —                                                                                          | —                  |
| Over 630 800 incl.                                    | ±1                                           | —                                                                                  | —                   | —                                                                                          | —                  |
| Over 800 1000 incl.                                   | ±1.1                                         | —                                                                                  | —                   | —                                                                                          | —                  |

Note 1) The dimensional tolerance for  $l_1$  shall be applied to partial dimension of die split surface which does not influence the length.

2) "Projected area of castings" means the circumference internal projected area of as-casted castings.

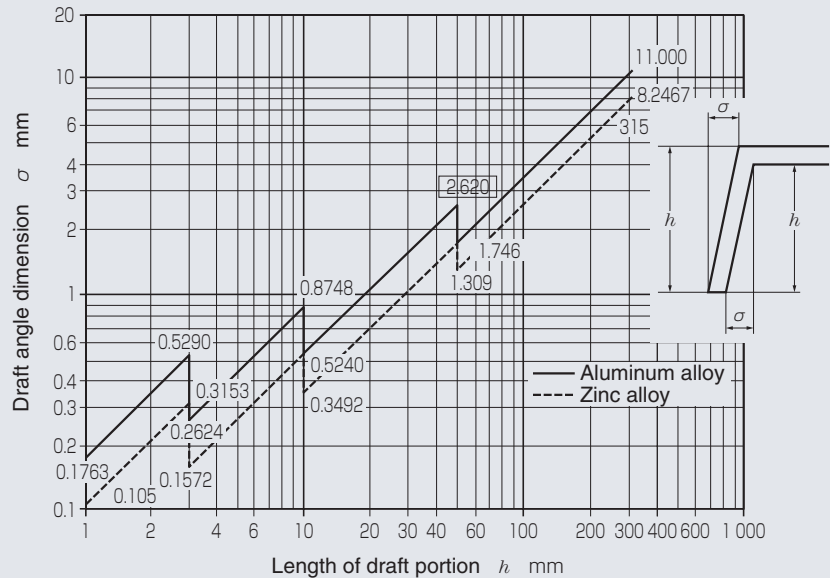


## Maximum draft angle value



Unit : degree

| Material                    | Aluminum alloy | Zinc alloy |
|-----------------------------|----------------|------------|
| Length of draft portion(mm) |                |            |
| 3 and less                  | 10             | 6          |
| Over 3 - 10 incl.           | 5              | 3          |
| Over 10 - 50 incl.          | 3              | 2          |
| Over 50 - 315 incl.         | 2              | 1.5        |

Chart showing the relationship of drafted portion length ( $h$ ) vs draft angle dimension ( $\sigma$ )

## 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.

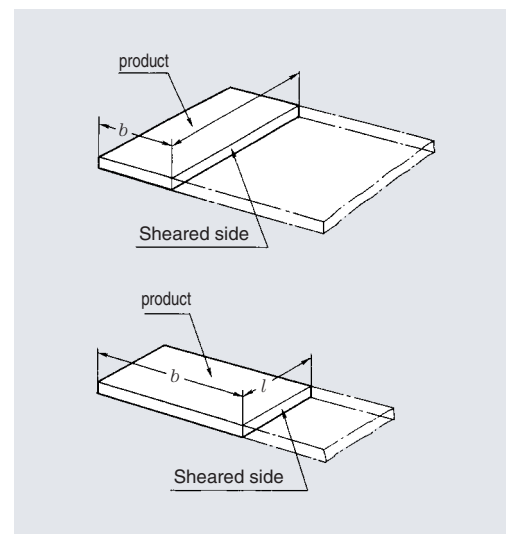
- (1) Cutting width: Distance from one side sheared by shear cutter to opposite side, as illustrated in Fig.  $b$
- (2) Cutting length: length of one side sheared by shear cutter, as illustrated in Fig.  $l$ .

## Ordinary tolerance for shearing width

Unit : mm

| Classification by plate thickness | 1.6 and less |         | Over 1.6 3 incl. |         | Over 3 6 incl. |         | Over 6 12 incl. |         |
|-----------------------------------|--------------|---------|------------------|---------|----------------|---------|-----------------|---------|
| Tolerance class                   | Class-A      | Class-B | Class-A          | Class-B | Class-A        | Class-B | Class-A         | Class-B |
| Cutting width division            |              |         |                  |         |                |         |                 |         |
| 120 and less                      | ±0.2         | ±0.5    | ±0.3             | ±0.5    | ±0.7           | ±1.2    | —               | ±1.6    |
| Over 120 - 315 incl.              | ±0.3         | ±0.6    | ±0.4             | ±0.8    | ±0.9           | ±1.6    | —               | ±2.0    |
| Over 315 - 1000 incl.             | ±0.5         | ±1.0    | ±0.5             | ±1.2    | ±1.6           | ±2.0    | —               | ±2.5    |
| Over 1000 - 2000 incl.            | ±0.8         | ±1.2    | ±0.8             | ±1.6    | ±2.0           | ±3.0    | —               | ±3.0    |
| Over 2000 - 3150 incl.            | ±1.0         | ±1.4    | ±1.0             | ±1.6    | ±2.8           | ±3.0    | —               | ±3.5    |

Remarks: non-applicable to cutting length exceeding 3150 mm.





Ordinary tolerance for straightness

Unit : mm

| Classification by plate thickness<br>Cutting width division | 1.6 and less |         | Over 1.6 3 incl. |         | Over 3 6 incl. |         |
|-------------------------------------------------------------|--------------|---------|------------------|---------|----------------|---------|
|                                                             | Class-A      | Class-B | Class-A          | Class-B | Class-A        | Class-B |
| 120 and less                                                | 0.2          | 0.3     | 0.2              | 0.3     | 0.5            | 0.8     |
| Over 120 - 315 incl.                                        | 0.3          | 0.5     | 0.3              | 0.6     | 1.0            | 1.6     |
| Over 315 - 1000 incl.                                       | 0.4          | 0.9     | 0.5              | 1.0     | 1.4            | 2.0     |
| Over 1000 - 2000 incl.                                      | 0.6          | 1.2     | 0.8              | 1.6     | 2.5            | 3.0     |
| Over 2000 - 3150 incl.                                      | 0.9          | 1.6     | 1.0              | 2.2     | 2.8            | 4.5     |

Remarks: Non-applicable to cutting width of less than 20 times as much as plate thickness or cutting width of less than 30mm.

Ordinary tolerance for straightness

Unit : mm

| Classification by plate thickness<br>Cutting width division | 3 and less |         | Over 3 6 incl. |         | Over 6 12 incl. |         |
|-------------------------------------------------------------|------------|---------|----------------|---------|-----------------|---------|
|                                                             | Class-A    | Class-B | Class-A        | Class-B | Class-A         | Class-B |
| 120 and less                                                | 0.3        | 0.5     | 0.5            | 1.0     | —               | 1.6     |
| Over 120 - 315 incl.                                        | 0.6        | 1.2     | 0.8            | 1.6     | —               | 2.0     |
| Over 315 - 1000 incl.                                       | 1.6        | 3.0     | 2.0            | 3.0     | —               | 3.0     |
| Over 1000 - 2000 incl.                                      | 3.0        | 6.0     | 4.0            | 6.0     | —               | 6.0     |
| Over 2000 - 3150 incl.                                      | 4.5        | 9.0     | 5.5            | 9.0     | —               | 9.0     |

## 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.

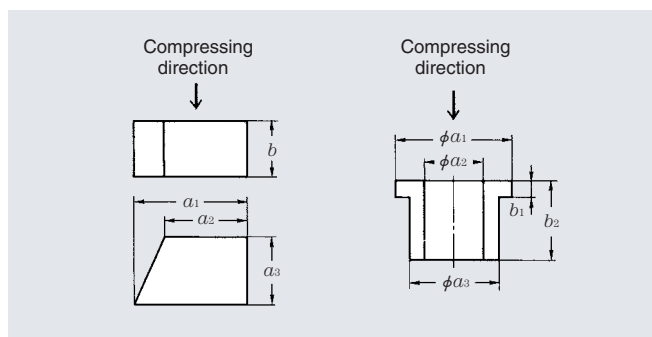
Ordinary tolerance shall be indicated by either one of the following methods (1) and (2).

- (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 | Fine class | Medium class | Coarse class |
|------------------------------|------------|--------------|--------------|
| 6 and less                   | $\pm 0.05$ | $\pm 0.1$    | $\pm 0.2$    |
| 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 - 315 incl.         | $\pm 0.2$  | $\pm 0.5$    | $\pm 1.2$    |

Ordinary tolerance for height

Unit : mm

| Dimensional division \ class | Fine class | Medium class | Coarse class |
|------------------------------|------------|--------------|--------------|
| 6 and less                   | $\pm 0.1$  | $\pm 0.2$    | $\pm 0.6$    |
| Over 6 - 30 incl.            | $\pm 0.2$  | $\pm 0.5$    | $\pm 1$      |
| Over 30 - 120 incl.          | $\pm 0.3$  | $\pm 0.8$    | $\pm 1.8$    |

## Ordinary tolerance for steel castings

JIS B 0412

This Standard specifies the ordinary tolerances for the length and as-casted wall thickness (hereinafter referred to as "ordinary tolerance") of steel castings casted by sand molds.

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 B0412, Medium Class

Tolerance class: The ordinary tolerance class shall be three classes of "Fine Class", "Medium Class" and "Coarse Class".

Ordinary tolerance for length

Unit : mm

| Dimensional division \ class | Fine class | Medium class | Coarse class |
|------------------------------|------------|--------------|--------------|
| 120 and less                 | ±1.8       | ± 2.8        | ± 4.5        |
| Over 120 - 315 incl.         | ±2.5       | ± 4          | ± 6          |
| Over 315 - 630 incl.         | ±3.5       | ± 5.5        | ± 9          |
| Over 630 - 1250 incl.        | ±5         | ± 8          | ±12          |
| Over 1250 - 2500 incl.       | ±9         | ±14          | ±22          |
| Over 2500 - 5000 incl.       | —          | ±20          | ±35          |
| Over 5000 - 10000 incl.      | —          | —            | ±63          |

Ordinary tolerance for wall thickness

Unit : mm

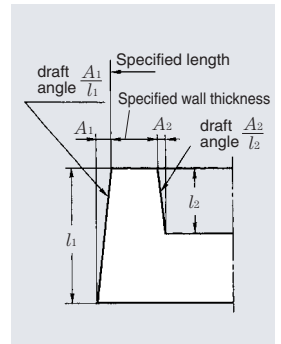
| Dimensional division \ class | Fine class | Medium class | Coarse class |
|------------------------------|------------|--------------|--------------|
| 18 and less                  | ±1.4       | ±2.2         | ± 3.5        |
| Over 18 - 50 incl.           | ±2         | ±3           | ± 5          |
| Over 50 - 120 incl.          | —          | ±4.5         | ± 7          |
| Over 120 - 250 incl.         | —          | ±5.5         | ± 9          |
| Over 250 - 400 incl.         | —          | ±7           | ±11          |
| Over 400 - 630 incl.         | —          | ±9           | ±14          |
| Over 630 - 1000 incl.        | —          | —            | ±18          |

Remarks: "Fine Class" shall be applied to minor steel castings subjected to special accuracy.

Dimension-A for draft angle

Unit : mm

| Dimensional division $l$ | Dimension A (max) |
|--------------------------|-------------------|
| 18 incl.                 | 1.4               |
| Over 18 50 incl.         | 2                 |
| Over 50 120 incl.        | 2.8               |
| Over 120 250 incl.       | 3.5               |
| Over 250 400 incl.       | 4.5               |
| Over 400 630 incl.       | 5.5               |
| Over 630 1000 incl.      | 7                 |



Remarks:  $l$  means  $l_1$  and  $l_2$  in the above sketch.  
 $A$  means  $A_1, A_2$  in the above sketch.

## Ordinary tolerance for aluminum alloy castings

JIS B 0414

This Standard specifies the ordinary tolerances (hereinafter referred to as "ordinary tolerance") for the length and wall thickness of aluminum alloy castings (hereinafter referred to as "castings") molded by sand mold and mold. However, this Standard is not applied to castings molded by precision molds using "Lost Wax Method", etc.

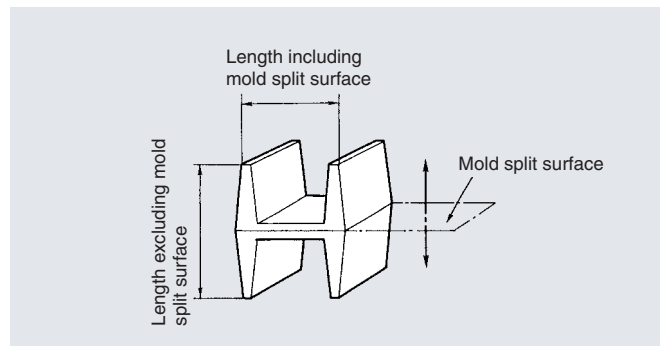
Ordinary tolerance shall be indicated by either one of the following methods (1) and (2).

- (1) Numerical value table for each dimensional division
- (2) Applicable Standard No. , classification and tolerance class by casting mold

Ex. JIS 0414 , Sand mold, Coarse Class

Definition of terms: The terms used in this Standard are as defined below.

Mold split surface: Two or more splitted surfaces of mold for drafting a model or a castings out of a casting mold.



## Ordinary tolerance for length

Unit : mm

| Type                     | Dimensional division                    | 50 incl.   |              | Over 50<br>120 incl. |              | Over 120<br>250 incl. |              | Over 250<br>400 incl. |              | Over 400<br>800 incl. |              | Over 800<br>1600 incl. |              | Over 1600<br>3150 incl. |              | (Ref.)<br>Correspond to standard<br>tolerance grade |              |
|--------------------------|-----------------------------------------|------------|--------------|----------------------|--------------|-----------------------|--------------|-----------------------|--------------|-----------------------|--------------|------------------------|--------------|-------------------------|--------------|-----------------------------------------------------|--------------|
|                          | class                                   | Fine class | Coarse class | Fine class           | Coarse class | Fine class            | Coarse class | Fine class            | Coarse class | Fine class            | Coarse class | Fine class             | Coarse class | Fine class              | Coarse class | Fine class                                          | Coarse class |
| Castings by sand mold    | Portion including no mold split surface | ±0.5       | ±1.1         | ±0.7                 | ±1.2         | ±0.9                  | ±1.4         | ±1.1                  | ±1.8         | ±1.6                  | ±2.5         | —                      | ±4           | —                       | ±7           | 15                                                  | 16           |
|                          | Portion including mold split surface    | ±0.8       | ±1.5         | ±1.1                 | ±1.8         | ±1.4                  | ±2.2         | ±1.8                  | ±2.8         | ±2.5                  | ±4.0         | —                      | ±6           | —                       | —            | 16                                                  | 17           |
| Castings by casting mold | Portion including no mold split surface | ±0.3       | ±0.5         | ±0.45                | ±0.7         | ±0.55                 | ±0.9         | ±0.7                  | ±1.1         | ±1.0                  | ±1.6         | —                      | —            | —                       | —            | 14                                                  | 15           |
|                          | Portion including mold split surface    | ±0.5       | ±0.6         | ±0.7                 | ±0.8         | ±0.9                  | ±1.0         | ±1.1                  | ±1.2         | ±1.6                  | ±1.8         | —                      | —            | —                       | —            | 15                                                  | 15           |

Note 1) Conforming to Appendix-2 to JIS B 0404 (Rule for Ordinary Dimensional Tolerances)

## Ordinary tolerance for wall thickness

Unit : mm

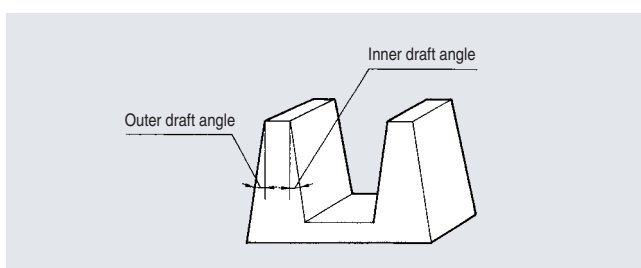
| Type                     | Dimensional division    |                 | 6 incl.    |              | Over 6<br>10 incl. |              | Over 10<br>18 incl. |              | Over 18<br>30 incl. |              | Over 30<br>50 incl. |              |
|--------------------------|-------------------------|-----------------|------------|--------------|--------------------|--------------|---------------------|--------------|---------------------|--------------|---------------------|--------------|
|                          | Max. length of castings | Tolerance class | Fine class | Coarse class | Fine class         | Coarse class | Fine class          | Coarse class | Fine class          | Coarse class | Fine class          | Coarse class |
| Castings by sand mold    | 120 incl.               |                 | ±0.6       | ±1.2         | ±0.7               | ±1.4         | ±0.8                | ±1.6         | ±0.9                | ±1.8         | —                   | —            |
|                          | Over 120 250 incl.      |                 | ±0.7       | ±1.3         | ±0.8               | ±1.5         | ±0.9                | ±1.7         | ±1.0                | ±1.9         | ±1.2                | ±2.3         |
|                          | Over 250 400 incl.      |                 | ±0.8       | ±1.4         | ±0.9               | ±1.6         | ±1.0                | ±1.8         | ±1.1                | ±2.0         | ±1.3                | ±2.4         |
|                          | Over 400 800 incl.      |                 | ±1.0       | ±1.6         | ±1.1               | ±1.8         | ±1.2                | ±2.0         | ±1.3                | ±2.2         | ±1.5                | ±2.6         |
| Castings by casting mold | 120 incl.               |                 | ±0.3       | ±0.7         | ±0.4               | ±0.9         | ±0.5                | ±1.1         | ±0.6                | ±1.3         | —                   | —            |
|                          | Over 120 250 incl.      |                 | ±0.4       | ±0.8         | ±0.5               | ±1.0         | ±0.6                | ±1.2         | ±0.7                | ±1.4         | ±0.9                | ±1.8         |
|                          | Over 250 400 incl.      |                 | ±0.5       | ±0.9         | ±0.6               | ±1.1         | ±0.7                | ±1.3         | ±0.8                | ±1.5         | ±1.0                | ±1.9         |

## Maximum draft angle value

Unit : degree

| Classification by draft angle | Outer      |              | Inner      |              |
|-------------------------------|------------|--------------|------------|--------------|
| Tolerance class               | Fine class | Coarse class | Fine class | Coarse class |
| Type of castings              |            |              |            |              |
| Fine class                    | 1          | 2            | 2          | 3            |
| Coarse class                  |            |              |            |              |

Remarks: The numerical values in this table shall be applied to draft portions of 400 mm and less in length.



## Dimensional tolerance for shaft

| Diameter division<br>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  |      |      |      |      |      |        |      |     |      |      |      |     |      |      |
| 50                      | 65    |  | - 340  | - 800  | -140 | - 440  | -100 | -119 | - 60 | - 79 | - 60 | - 520  | -30  | -43 | - 30 | - 49 | -10  | -23 | -10  | - 29 |
| 65                      | 80    |  | - 360  | - 820  | -150 | - 450  |      |      |      |      |      |        |      |     |      |      |      |     |      |      |
| 80                      | 100   |  | - 380  | - 920  | -170 | - 520  | -120 | -142 | - 72 | - 94 | - 72 | - 612  | -36  | -51 | - 36 | - 58 | -12  | -27 | -12  | - 34 |
| 100                     | 120   |  | - 410  | - 950  | -180 | - 530  |      |      |      |      |      |        |      |     |      |      |      |     |      |      |
| 120                     | 140   |  | - 460  | -1 090 | -200 | - 600  | -145 | -170 | - 85 | -110 | - 85 | - 715  | -43  | -61 | - 43 | - 68 | -14  | -32 | -14  | - 39 |
| 140                     | 160   |  | - 520  | -1 150 | -210 | - 610  |      |      |      |      |      |        |      |     |      |      |      |     |      |      |
| 160                     | 180   |  | - 580  | -1 210 | -230 | - 630  |      |      |      |      |      |        |      |     |      |      |      |     |      |      |
| 180                     | 200   |  | - 660  | -1 380 | -240 | - 700  | -170 | -199 | -100 | -129 | -100 | - 820  | -50  | -70 | - 50 | - 79 | -15  | -35 | -15  | - 44 |
| 200                     | 225   |  | - 740  | -1 460 | -260 | - 720  |      |      |      |      |      |        |      |     |      |      |      |     |      |      |
| 225                     | 250   |  | - 820  | -1 540 | -280 | - 740  |      |      |      |      |      |        |      |     |      |      |      |     |      |      |
| 250                     | 280   |  | - 920  | -1 730 | -300 | - 820  | -190 | -222 | -110 | -142 | -110 | - 920  | -56  | -79 | - 56 | - 88 | -17  | -40 | -17  | - 49 |
| 280                     | 315   |  | -1 050 | -1 860 | -330 | - 850  |      |      |      |      |      |        |      |     |      |      |      |     |      |      |
| 315                     | 355   |  | -1 200 | -2 090 | -360 | - 930  | -210 | -246 | -125 | -161 | -125 | -1 015 | -62  | -87 | - 62 | - 98 | -18  | -43 | -18  | - 54 |
| 355                     | 400   |  | -1 350 | -2 240 | -400 | - 970  |      |      |      |      |      |        |      |     |      |      |      |     |      |      |
| 400                     | 450   |  | -1 500 | -2 470 | -440 | -1 070 | -230 | -270 | -135 | -175 | -135 | -1 105 | -68  | -95 | - 68 | -108 | -20  | -47 | -20  | - 60 |
| 450                     | 500   |  | -1 650 | -2 620 | -480 | -1 110 |      |      |      |      |      |        |      |     |      |      |      |     |      |      |
| 500                     | 560   |  | -      | -      | -    | -      | -260 | -304 | -145 | -189 | -    | -      | -    | -   | - 76 | -120 | -    | -   | -22  | - 66 |
| 560                     | 630   |  | -      | -      | -    | -      |      |      |      |      |      |        | -    | -   | - 80 | -130 | -    | -   | -24  | - 74 |
| 630                     | 710   |  | -      | -      | -    | -      | -290 | -340 | -160 | -210 | -    | -      | -    | -   | -    | -    | -    | -   | -    | -    |
| 710                     | 800   |  | -      | -      | -    | -      |      |      |      |      |      |        | -    | -   | - 86 | -142 | -    | -   | -26  | - 82 |
| 800                     | 900   |  | -      | -      | -    | -      | -320 | -376 | -170 | -226 | -    | -      | -    | -   | -    | -    | -    | -   | -    | -    |
| 900                     | 1 000 |  | -      | -      | -    | -      |      |      |      |      |      |        | -    | -   | - 98 | -164 | -    | -   | -28  | - 94 |
| 1 000                   | 1 120 |  | -      | -      | -    | -      | -350 | -416 | -195 | -261 | -    | -      | -    | -   | -    | -    | -    | -   | -    | -    |
| 1 120                   | 1 250 |  | -      | -      | -    | -      |      |      |      |      |      |        | -    | -   | -    | -    | -    | -   | -    | -    |
| 1 250                   | 1 400 |  | -      | -      | -    | -      | -390 | -468 | -220 | -298 | -    | -      | -    | -   | -110 | -188 | -    | -   | -30  | -108 |
| 1 400                   | 1 600 |  | -      | -      | -    | -      |      |      |      |      |      |        | -    | -   | -    | -    | -    | -   | -    | -    |

| Diameter division<br>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    |  |      |     |       |       |      |     |       |       |      |     |      |     |      |     |      |     |      |     |
| 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    |  |      |     |       |       |      |     |       |       |      |     |      |     |      |     |      |     |      |     |
| 80                      | 100   |  | +6   | - 9 | + 7.5 | - 7.5 | +13  | - 9 | +11   | -11   | +20  | -15 | +13  | +3  | +18  | +3  | +25  | +3  | +28  | +13 |
| 100                     | 120   |  |      |     |       |       |      |     |       |       |      |     |      |     |      |     |      |     |      |     |
| 120                     | 140   |  | +7   | -11 | + 9   | - 9   | +14  | -11 | +12.5 | -12.5 | +22  | -18 | +15  | +3  | +21  | +3  | +28  | +3  | +33  | +15 |
| 140                     | 160   |  |      |     |       |       |      |     |       |       |      |     |      |     |      |     |      |     |      |     |
| 160                     | 180   |  |      |     |       |       |      |     |       |       |      |     |      |     |      |     |      |     |      |     |
| 180                     | 200   |  | +7   | -13 | +10   | -10   | +16  | -13 | +14.5 | -14.5 | +25  | -21 | +18  | +4  | +24  | +4  | +33  | +4  | +37  | +17 |
| 200                     | 225   |  |      |     |       |       |      |     |       |       |      |     |      |     |      |     |      |     |      |     |
| 225                     | 250   |  |      |     |       |       |      |     |       |       |      |     |      |     |      |     |      |     |      |     |
| 250                     | 280   |  | +7   | -16 | +11.5 | -11.5 | +16  | -16 | +16   | -16   | +26  | -26 | +20  | +4  | +27  | +4  | +36  | +4  | +43  | +20 |
| 280                     | 315   |  |      |     |       |       |      |     |       |       |      |     |      |     |      |     |      |     |      |     |
| 315                     | 355   |  | +7   | -18 | +12.5 | -12.5 | +18  | -18 | +18   | -18   | +29  | -28 | +22  | +4  | +29  | +4  | +40  | +4  | +46  | +21 |
| 355                     | 400   |  |      |     |       |       |      |     |       |       |      |     |      |     |      |     |      |     |      |     |
| 400                     | 450   |  | +7   | -20 | +13.5 | -13.5 | +20  | -20 | +20   | -20   | +31  | -32 | +25  | +5  | +32  | +5  | +45  | +5  | +50  | +23 |
| 450                     | 500   |  |      |     |       |       |      |     |       |       |      |     |      |     |      |     |      |     |      |     |
| 500                     | 560   |  | -    | -   | -     | -     | -    | -   | +22   | -22   | -    | -   | -    | -   | -    | -   | +44  | 0   | -    | -   |
| 560                     | 630   |  |      |     |       |       |      |     |       |       |      |     | -    | -   | -    | -   |      |     |      |     |
| 630                     | 710   |  | -    | -   | -     | -     | -    | -   | +25   | -25   | -    | -   | -    | -   | -    | -   | +50  | 0   | -    | -   |
| 710                     | 800   |  |      |     |       |       |      |     |       |       |      |     | -    | -   | -    | -   |      |     |      |     |
| 800                     | 900   |  | -    | -   | -     | -     | -    | -   | +28   | -28   | -    | -   | -    | -   | -    | -   | +56  | 0   | -    | -   |
| 900                     | 1 000 |  |      |     |       |       |      |     |       |       |      |     | -    | -   | -    | -   |      |     |      |     |
| 1 000                   | 1 120 |  | -    | -   | -     | -     | -    | -   | +33   | -33   | -    | -   | -    | -   | -    | -   | +66  | 0   | -    | -   |
| 1 120                   | 1 250 |  |      |     |       |       |      |     |       |       |      |     | -    | -   | -    | -   |      |     |      |     |
| 1 250                   | 1 400 |  | -    | -   | -     | -     | -    | -   | +39   | -39   | -    | -   | -    | -   | -    | -   | +78  | 0   | -    | -   |
| 1 400                   | 1 600 |  |      |     |       |       |      |     |       |       |      |     | -    | -   | -    | -   |      |     |      |     |

Unit :  $\mu\text{m}$ 

| h4   |     | h5   |     | h6   |     | h7   |      | h8   |      | h9   |      | h10  |      | h11  |      | h13  |      | js4  |      | Diameter division<br>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<br>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 | +266 | +210 | +300 | +210 | -               | -   | -   | 90  | 800                     | 900   |
|      |     |      |     |      |     |      |     |      |      |      |      |      |      |                 |     |     |     | 900                     | 1 000 |
| +106 | +40 | -    | -   | +132 | +66 | -    | -   | +186 | +120 | +316 | +250 | +355 | +250 | -               | -   | -   | 105 | 1 000                   | 1 120 |
|      |     |      |     |      |     |      |     |      |      |      |      |      |      |                 |     |     |     | 1 120                   | 1 250 |
| +126 | +48 | -    | -   | +156 | +78 | -    | -   | +218 | +140 | +378 | +300 | +425 | +300 | -               | -   | -   | 125 | 1 250                   | 1 400 |
|      |     |      |     |      |     |      |     |      |      |      |      |      |      |                 |     |     |     | 1 400                   | 1 600 |

Dimensional tolerance for housing bore

| Diameter division<br>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   |
| 50                      | 65    | + 90 | + 60 | +180 | + 60 | +250 | + 60 | +360 | + 60 | + 49 | + 30 | + 60 | + 30 | + 76 | + 30 | + 29 | +10 | + 40 | +10 | +19  | 0   |
| 80                      | 100   | +107 | + 72 | +212 | + 72 | +292 | + 72 | +422 | + 72 | + 58 | + 36 | + 71 | + 36 | + 90 | + 36 | + 34 | +12 | + 47 | +12 | +22  | 0   |
| 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                     | 1 000 |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |     |      |     |      |     |
| 1 000                   | 1 120 | +300 | +195 | —    | —    | —    | —    | —    | —    | +164 | + 98 | +203 | + 98 | +263 | + 98 | + 94 | +28 | +133 | +28 | +66  | 0   |
| 1 120                   | 1 250 |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |     |      |     |      |     |
| 1 250                   | 1 400 | +345 | +220 | —    | —    | —    | —    | —    | —    | +188 | +110 | +235 | +110 | +305 | +110 | +108 | +30 | +155 | +30 | +78  | 0   |
| 1 400                   | 1 600 |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |     |      |     |      |     |
| 1 600                   | 1 800 | +390 | +240 | —    | —    | —    | —    | —    | —    | +212 | +120 | +270 | +120 | +350 | +120 | +124 | +32 | +182 | +32 | +92  | 0   |
| 1 800                   | 2 000 |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |     |      |     |      |     |

Unit :  $\mu\text{m}$ 

| Diameter division<br>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    |      |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      | - 37 | - 56 | - 32 | - 62 |
| 80                      | 100   | +4   | -18 | +10  | - 25 | - 6  | - 28 | 0    | - 35 | -16  | - 38 | -10  | - 45 | - 30 | - 52 | - 24 | - 59 | - 44 | - 66 | - 38 | - 73 |
| 100                     | 120   |      |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      | - 47 | - 69 | - 41 | - 76 |
| 120                     | 140   |      |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      | - 56 | - 81 | - 48 | - 88 |
| 140                     | 160   | +4   | -21 | +12  | - 28 | - 8  | - 33 | 0    | - 40 | -20  | - 45 | - 12 | - 52 | - 36 | - 61 | - 28 | - 68 | - 58 | - 83 | - 50 | - 90 |
| 160                     | 180   |      |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      | - 61 | - 86 | - 53 | - 93 |
| 180                     | 200   |      |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      | - 68 | - 97 | - 60 | -106 |
| 200                     | 225   | +5   | -24 | +13  | - 33 | - 8  | - 37 | 0    | - 46 | -22  | - 51 | -14  | - 60 | - 41 | - 70 | - 33 | - 79 | - 71 | -100 | - 63 | -109 |
| 225                     | 250   |      |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      | - 75 | -104 | - 67 | -113 |
| 250                     | 280   | +5   | -27 | +16  | - 36 | - 9  | - 41 | 0    | - 52 | -25  | - 57 | -14  | - 66 | - 47 | - 79 | - 36 | - 88 | - 85 | -117 | - 74 | -126 |
| 280                     | 315   |      |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      | - 89 | -121 | - 78 | -130 |
| 315                     | 355   | +7   | -29 | +17  | - 40 | -10  | - 46 | 0    | - 57 | -26  | - 62 | -16  | - 73 | - 51 | - 87 | - 41 | - 98 | - 97 | -133 | - 87 | -144 |
| 355                     | 400   |      |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      | -103 | -139 | - 93 | -150 |
| 400                     | 450   | +8   | -32 | +18  | - 45 | -10  | - 50 | 0    | - 63 | -27  | - 67 | -17  | - 80 | - 55 | - 95 | - 45 | -108 | -113 | -153 | -103 | -166 |
| 450                     | 500   |      |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      | -119 | -159 | -109 | -172 |
| 500                     | 560   | 0    | -44 | 0    | - 70 | -26  | - 70 | -26  | - 96 | -44  | - 88 | -44  | -114 | - 78 | -122 | - 78 | -148 | -150 | -194 | -150 | -220 |
| 560                     | 630   |      |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      | -155 | -199 | -155 | -225 |
| 630                     | 710   | 0    | -50 | 0    | - 80 | -30  | - 80 | -30  | -100 | -50  | -100 | -50  | -130 | - 88 | -138 | - 88 | -168 | -175 | -225 | -175 | -225 |
| 710                     | 800   |      |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      | -185 | -235 | -185 | -265 |
| 800                     | 900   | 0    | -56 | 0    | - 90 | -34  | - 90 | -34  | -124 | -56  | -112 | -56  | -146 | -100 | -156 | -100 | -190 | -210 | -266 | -210 | -300 |
| 900                     | 1 000 |      |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      | -220 | -276 | -220 | -310 |
| 1 000                   | 1 120 | 0    | -66 | 0    | -105 | -40  | -106 | -40  | -145 | -66  | -132 | -66  | -171 | -120 | -186 | -120 | -225 | -250 | -316 | -250 | -355 |
| 1 120                   | 1 250 |      |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      | -260 | -326 | -260 | -365 |
| 1 250                   | 1 400 | 0    | -78 | 0    | -125 | -48  | -126 | -48  | -173 | -78  | -156 | -78  | -203 | -140 | -213 | -140 | -265 | -300 | -378 | -300 | -425 |
| 1 400                   | 1 600 |      |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      | -330 | -408 | -330 | -455 |
| 1 600                   | 1 800 | 0    | -92 | 0    | -150 | -58  | -150 | -58  | -208 | -92  | -184 | -92  | -242 | -170 | -262 | -170 | -320 | -370 | -462 | -370 | -520 |
| 1 800                   | 2 000 |      |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      | -400 | -492 | -400 | -550 |

Unit :  $\mu\text{m}$ 

| H7     | H8     | H9     | H10    | H11    | H13    | J6     | Js6   |       | J7      | Js7   |       | K5     | Diameter division<br>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   | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 35.322 | 60.722 | 86.122  | 111.522 | 136.922 | 162.322 | 187.722 | 213.122 | 238.522 |
| 27/64    | 0.421875 | 10.716 | 35.719 | 61.119 | 86.519  | 111.919 | 137.319 | 162.719 | 188.119 | 213.519 | 238.919 |
| 7/16     | 0.437500 | 11.112 | 36.116 | 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  | 112.721 | 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 | 65.088 | 65.088 | 90.884  | 116.284 | 141.684 | 167.084 | 192.484 | 217.884 | 243.284 |
| 39/64    | 0.609375 | 15.478 | 65.481 | 65.481 | 91.281  | 116.681 | 142.081 | 167.481 | 192.881 | 218.281 | 243.681 |
| 5/ 8     | 0.625000 | 15.875 | 65.878 | 65.878 | 91.678  | 117.078 | 142.478 | 167.878 | 193.278 | 218.678 | 244.078 |
| 41/64    | 0.640625 | 16.272 | 66.275 | 66.275 | 92.075  | 117.475 | 142.875 | 168.275 | 193.675 | 219.075 | 244.475 |
| 21/32    | 0.656250 | 16.669 | 66.672 | 66.672 | 92.472  | 117.872 | 143.272 | 168.672 | 194.072 | 219.472 | 244.872 |
| 43/64    | 0.671875 | 17.066 | 67.069 | 67.069 | 92.869  | 118.269 | 143.669 | 169.069 | 194.469 | 219.869 | 245.269 |
| 11/16    | 0.687500 | 17.462 | 67.466 | 67.466 | 93.266  | 118.666 | 144.066 | 169.466 | 194.866 | 220.266 | 245.666 |
| 45/64    | 0.703125 | 17.859 | 67.862 | 67.862 | 93.662  | 119.062 | 144.462 | 169.862 | 195.262 | 220.662 | 246.062 |
| 23/32    | 0.718750 | 18.256 | 68.259 | 68.259 | 94.059  | 119.459 | 144.859 | 170.259 | 195.659 | 221.056 | 246.459 |
| 47/64    | 0.734375 | 18.653 | 68.656 | 68.656 | 94.456  | 119.856 | 145.256 | 170.656 | 196.056 | 221.456 | 246.856 |
| 3/ 4     | 0.750000 | 19.050 | 69.056 | 69.056 | 94.853  | 120.253 | 145.653 | 171.053 | 196.453 | 221.853 | 247.253 |
| 49/64    | 0.765625 | 19.447 | 69.453 | 69.453 | 95.250  | 120.650 | 146.050 | 171.450 | 196.850 | 222.250 | 247.650 |
| 25/32    | 0.781250 | 19.844 | 69.850 | 69.850 | 95.647  | 121.047 | 146.447 | 171.847 | 197.247 | 222.647 | 248.047 |
| 51/64    | 0.796875 | 20.241 | 70.247 | 70.247 | 96.044  | 121.444 | 146.844 | 172.244 | 197.644 | 223.044 | 248.444 |
| 13/16    | 0.812500 | 20.638 | 70.644 | 70.644 | 96.441  | 121.841 | 147.241 | 172.641 | 198.041 | 223.441 | 248.841 |
| 53/64    | 0.828125 | 21.034 | 71.041 | 71.041 | 96.838  | 122.238 | 147.638 | 173.038 | 198.438 | 223.838 | 249.238 |
| 27/32    | 0.843750 | 21.431 | 71.438 | 71.438 | 97.234  | 122.634 | 148.034 | 173.434 | 198.834 | 224.234 | 249.634 |
| 55/64    | 0.859375 | 21.828 | 71.834 | 71.834 | 97.631  | 123.031 | 148.431 | 173.831 | 199.231 | 224.631 | 250.031 |
| 7/ 8     | 0.875000 | 22.225 | 72.231 | 72.231 | 98.028  | 123.428 | 148.828 | 174.228 | 199.628 | 225.028 | 250.428 |
| 57/64    | 0.890625 | 22.622 | 72.628 | 72.628 | 98.425  | 123.825 | 149.225 | 174.625 | 200.025 | 225.425 | 250.825 |
| 39/32    | 0.906250 | 23.019 | 73.025 | 73.025 | 98.822  | 124.222 | 149.622 | 175.022 | 200.422 | 225.822 | 251.222 |
| 59/64    | 0.921875 | 23.416 | 73.422 | 73.422 | 99.219  | 124.619 | 150.019 | 175.419 | 200.819 | 226.219 | 251.619 |
| 15/16    | 0.937500 | 23.812 | 73.819 | 73.819 | 99.616  | 125.016 | 150.416 | 175.816 | 201.216 | 226.616 | 252.016 |
| 61/64    | 0.953125 | 24.209 | 74.216 | 74.216 | 100.012 | 125.412 | 150.812 | 176.212 | 201.612 | 227.012 | 252.412 |
| 31/32    | 0.968750 | 24.606 | 74.612 | 74.612 | 100.409 | 125.809 | 151.209 | 176.609 | 202.009 | 227.409 | 252.809 |
| 63/64    | 0.984375 | 25.003 | 75.009 | 75.009 | 100.806 | 126.206 | 151.606 | 177.006 | 202.406 | 227.806 | 253.206 |
|          |          | 25.003 | 75.406 | 75.406 | 101.203 | 126.603 | 152.003 | 177.403 | 202.803 | 228.203 | 253.603 |