MOTION & CONTROL™

NSK

# ROLLING BEARINGS



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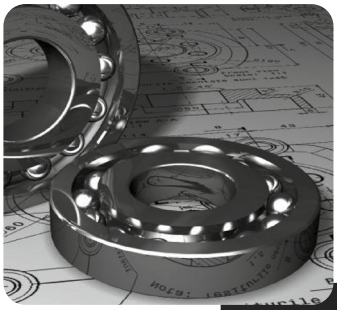

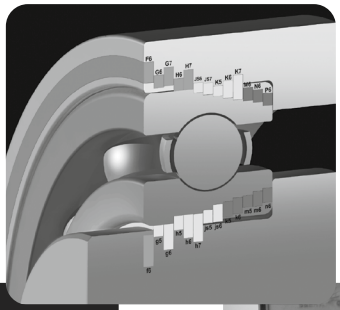






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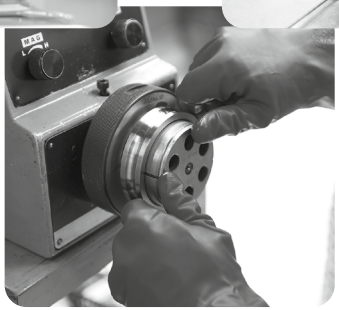



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# 1. Types and Features of Rolling Bearings

## 1.1 Design and Classification

Rolling bearings generally consist of two rings, rolling elements, and a cage, and they are classified into radial bearings or thrust bearings depending on the direction of the main load. In addition, depending on the type of rolling elements, they are classified into ball bearings or roller bearings, and they are further segregated by differences in their design or specific purpose.

The most common bearing types and nomenclature of bearing parts are shown in Fig.1.1, and a general classification of rolling bearings is shown in Fig. 1.2.

## 1.2 Characteristics of Rolling Bearings

Compared with plain bearings, rolling bearings have the following major advantages:

(1) Their starting torque or friction is low and the difference between the starting torque and running torque is small.

(2) With the advancement of worldwide standardization, rolling bearings are internationally available and interchangeable.

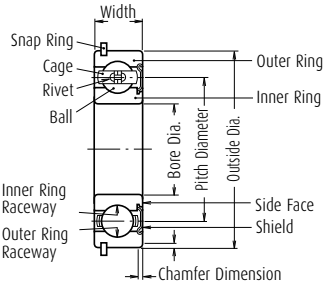
(3) Maintenance, replacement, and inspection are easy because the structure surrounding rolling bearings is simple.

(4) Many rolling bearings are capable of taking both radial and axial loads simultaneously or independently.

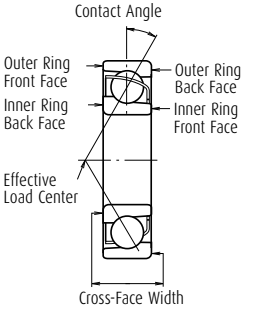
(5) Rolling bearings can be used under a wide range of temperatures.

(6) Rolling bearings can be preloaded to produce a negative clearance and achieve greater rigidity.

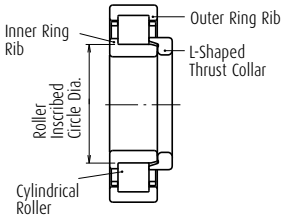
Furthermore, different types of rolling bearings have their own individual advantages. The features of the most common rolling bearings are described on Pages A010 to A013 and in Table 1.1 (Pages A014 and A015).



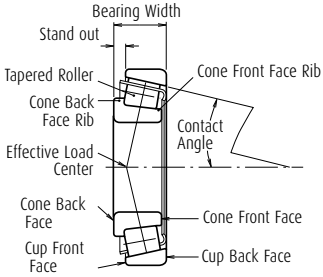

Single-Row Deep Groove Ball Bearing



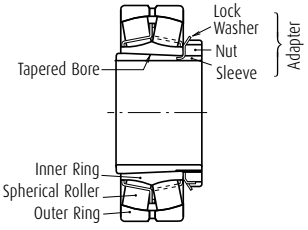

Single-Row Angular Contact Ball Bearing



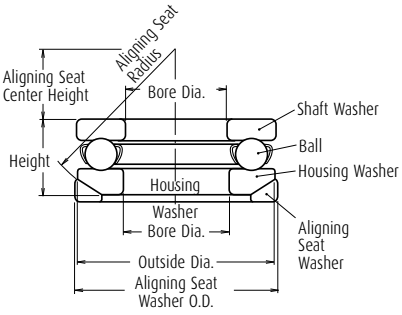

Cylindrical Roller Bearing




Tapered Roller Bearing




Spherical Roller Bearing




Single-Direction Thrust Ball Bearing

Fig. 1.1 Name of Bearing Parts

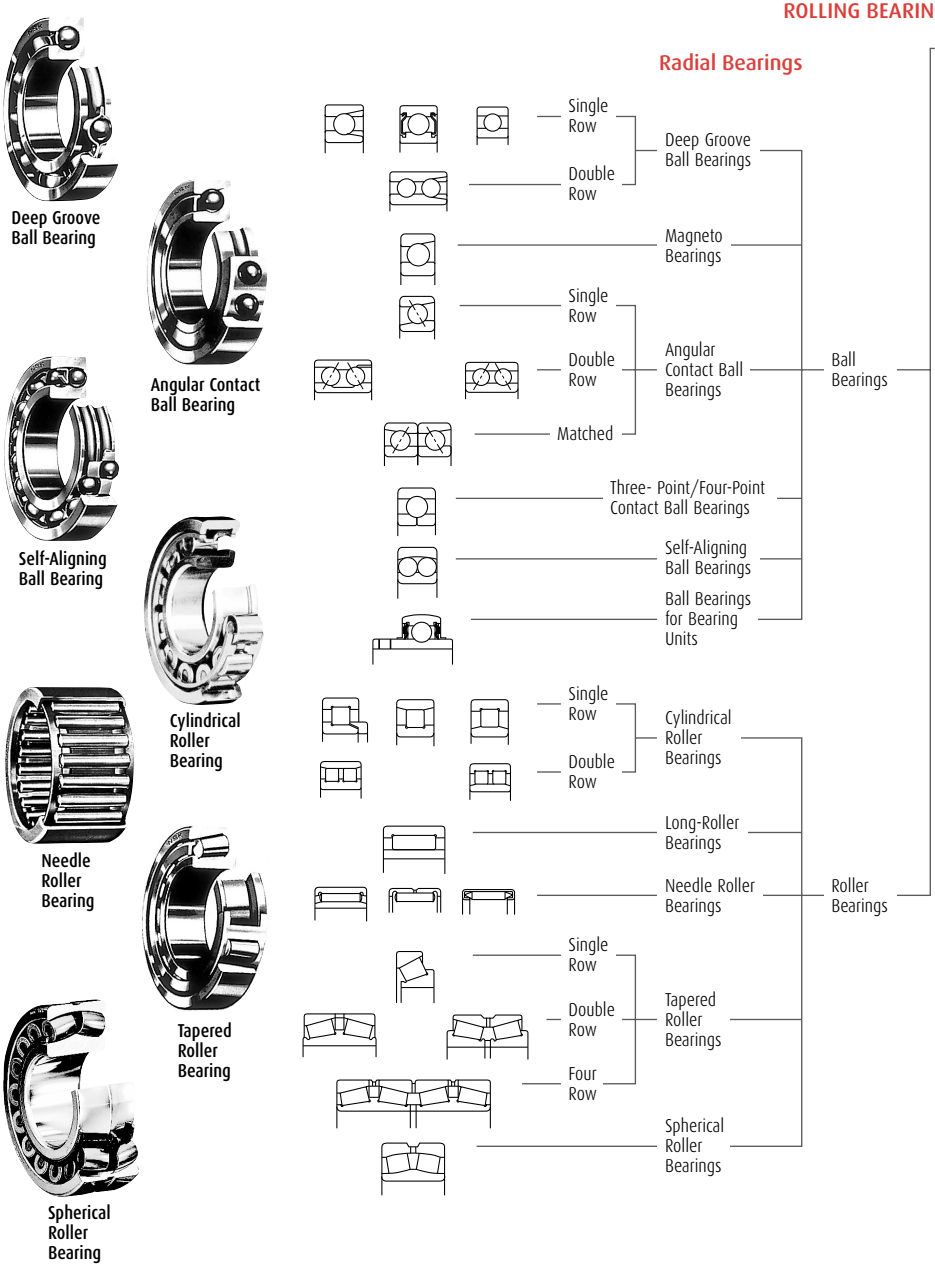



Fig. 1.2 Classification of Rolling Bearings

## Thrust Bearings

- Ball Bearings
  - Thrust Ball Bearings
    - Single Direction
    - Double Direction
  - Angular Contact Thrust Ball Bearings
- Roller Bearings
  - Thrust Cylindrical Roller Bearings
  - Thrust Needle Roller Bearings
  - Thrust Tapered Roller Bearings
  - Thrust Spherical Roller Bearings
- Bearings for Specific Uses
  - Automotive Clutch Release Bearings
  - Automotive Water Pump Bearings
  - Rolling Stock Axle Bearings
  - Crane-Sheave Bearings
  - Chain Conveyor Bearings
  - Others



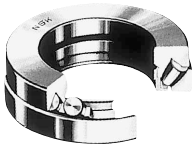
**Single-Direction Thrust Ball Bearing**



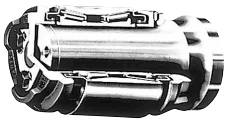
**Thrust Cylindrical Roller Bearing**



**Thrust Tapered Roller Bearing**



**Thrust Spherical Roller Bearing**

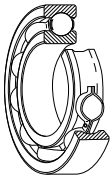


**Sealed Axle Bearing**



**Cylindrical Roller Bearing for Sheaves**

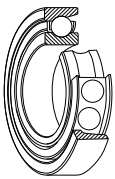
**Single-Row Deep Groove Ball Bearings**



Single-row deep groove ball bearings are the most common type of rolling bearings. Their use is very widespread. The raceway grooves on both the inner and outer rings have circular arcs of slightly larger radius than that of the balls. In addition to radial loads, axial loads can be imposed in either direction. Because of their low torque, they are highly suitable for applications where high speeds and low power loss are required.

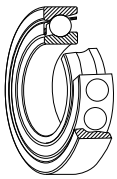
In addition to open type bearings, these bearings often have steel shields or rubber seals installed on one or both sides and are prelubricated with grease. Also, snap rings are sometimes used on the periphery. As to cages, pressed steel ones are the most common.

**Magneto Bearings**



The inner groove of magneto bearings is a little shallower than that of deep groove bearings. Since the outer ring has a shoulder on only one side, the outer ring may be removed. This is often advantageous for mounting. In general, two such bearings are used in duplex pairs. Magneto bearings are small bearings with a bore diameter of 4 to 20 mm and are mainly used for small magnetos, gyroscopes, instruments, etc. Pressed brass cages are generally used.

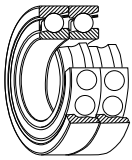
**Single-Row Angular Contact Ball Bearings**



Individual bearings of this type are capable of taking radial loads and also axial loads in one direction. Four contact angles of 15°, 25°, 30°, and 40° are available. The larger the contact angle, the higher the axial load capacity. For high speed operation, however, the smaller contact angles are preferred. Usually, two bearings are used in duplex pairs, and the clearance between them must be adjusted properly.

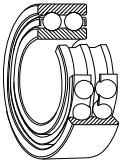
Pressed-steel cages are commonly used, however, for high precision bearings with a contact angle less than 30°, polyamide resin cages are often used.

**Duplex Bearings**



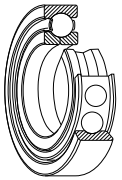
A combination of two radial bearings is called a duplex pair. Usually, they are formed using angular contact ball bearings or tapered roller bearings. Possible combinations include face-to-face, which have the outer ring faces together (type DF), back-to-back (type DB), or both front faces in the same direction (type DT). DF and DB duplex bearings are capable of taking radial loads and axial loads in either direction. Type DT is used when there is a strong axial load in one direction and it is necessary to impose the load equally on each bearing.

**Double-Row Angular Contact Ball Bearings**



Double-row angular contact ball bearings are basically two single-row angular contact ball bearings mounted back-to-back except that they have only one inner ring and one outer ring, each having raceways. They can take axial loads in either direction.

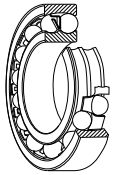
**Four-Point Contact Ball Bearings**



The inner and outer rings of four-point contact ball bearings are separable because the inner ring is split in a radial plane. They can take axial loads from either direction. The balls have a contact angle of 35° with each ring. Just one bearing of this type can replace a combination of face-to-face or back-to-back angular contact bearings.

Machined brass cages are generally used.

**Self-Aligning Ball Bearings**



The inner ring of this type of bearing has two raceways and the outer ring has a single spherical raceway with its center of curvature coincident with the bearing axis. Therefore, the axis of the inner ring, balls, and cage can deflect to some extent around the bearing center. Consequently, minor angular misalignment of the shaft and housing caused by machining or mounting error is automatically corrected.

This type of bearing often has a tapered bore for mounting using an adapter sleeve.

**Cylindrical Roller Bearings**



In bearings of this type, the cylindrical rollers are in linear contact with the raceways. They have a high radial load capacity and are suitable for high speeds.

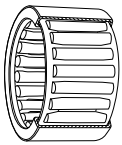
There are different types designated NU, NJ, NUP, N, NF for single-row bearings, and NNU, NN for double-row bearings depending on the presence or absence of side ribs.

The outer and inner rings of all types are separable.

Some cylindrical roller bearings have no ribs on either the inner or outer ring, so the rings can move axially relative to each other. These can be used as free-end bearings. Cylindrical roller bearings, in which either the inner or outer rings has two ribs and the other ring has one, are capable of taking some axial load in one direction. Double-row cylindrical roller bearings have high radial rigidity and are used primarily for precision machine tools.

Pressed steel or machined brass cages are generally used, but sometimes molded polyamide cages are also used.

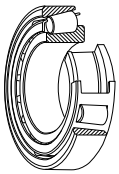
**Needle Roller Bearings**



Needle roller bearings contain many slender rollers with a length 3 to 10 times their diameter. As a result, the ratio of the bearing outside diameter to the inscribed circle diameter is small, and they have a rather high radial load capacity.

There are numerous types available, and many have no inner rings. The drawn-cup type has a pressed steel outer ring and the solid type has a machined outer ring. There are also cage and roller assemblies without rings. Most bearings have pressed steel cages, but some are without cages.

**Tapered Roller Bearings**



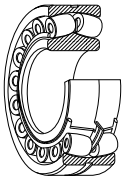
Bearings of this type use conical rollers guided by a back-face rib on the cone. These bearings are capable of taking high radial loads and also axial loads in one direction. In the HR series, the rollers are increased in both size and number giving it an even higher load capacity.

They are generally mounted in pairs in a manner similar to single-row angular contact ball bearings. In this case, the proper internal clearance can be obtained by adjusting the axial distance between the cones or cups of the two opposed bearings. Since they are separable, the cone assemblies and cups can be mounted independently.

Depending upon the contact angle, tapered roller bearings are divided into three types called normal angle, medium angle, and steep angle. Double-row and four-row tapered roller bearings are also available.

Pressed steel cages are generally used.

**Spherical Roller Bearings**



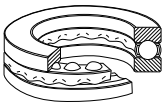
These bearings have barrel-shaped rollers between the inner ring, which has two raceways, and the outer ring which has one spherical raceway. Since the center of curvature of the outer ring raceway surface coincides with the bearing axis, they are self-aligning in a manner similar to that of self-aligning ball bearings. Therefore, if there is deflection of the shaft or housing or misalignment of their axes, it is automatically corrected so excessive force is not applied to the bearings.

Spherical roller bearings can take not only heavy radial loads, but also some axial loads in either direction. They have excellent radial load-carrying capacity and are suitable for use where there are heavy or impact loads.

Some bearings have tapered bores and may be mounted directly on tapered shafts or cylindrical shafts using adapters or withdrawal sleeves.

Pressed steel and machined brass cages are used.

### Single-Direction Thrust Ball Bearings



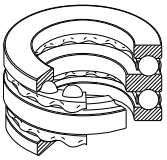
Single-direction thrust ball bearings are composed of washer-like bearing rings with raceway grooves. The ring attached to the shaft is called the shaft washer (or inner ring) while that attached to the housing is called the housing washer (or outer ring).

In double-direction thrust ball bearings, there are three rings with the middle one (center ring) being fixed to the shaft.

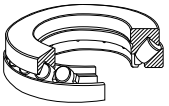
There are also thrust ball bearings with an aligning seat washer beneath the housing washer in order to compensate for shaft misalignment or mounting error.

Pressed steel cages are usually used in the smaller bearings and machined cages in the larger ones.

### Double-Direction Thrust Ball Bearings



### Spherical Thrust Roller Bearings



These bearings have a spherical raceway in the housing washer and barrel-shaped rollers obliquely arranged around it. Since the raceway in the housing washer in spherical, these bearings are self-aligning. They have a very high axial load capacity and are capable of taking moderate radial loads when an axial load is applied.

Pressed steel cages or machined brass cages are usually used.

## Table 1.1 Types and Characteristics of Rolling Bearings

| Features \ Bearing Types | Deep Groove Ball Bearings | Magneto Bearings | Angular Contact Ball Bearings | Double-Row Angular Contact Ball Bearings | Duplex Angular Contact Ball Bearings | Four-Point Contact Ball Bearings | Self-Aligning Ball Bearings | Cylindrical Roller Bearings | Double-Row Cylindrical Roller Bearings | Cylindrical Roller Bearings with Single Rib |
|---|---|---|---|---|---|---|---|---|---|---|
| Load Capacity — Radial Loads | ◯ | ○ | ◎ | ◎ | ◎ | ○ | ◯ | ◎ | ◉ | ◎ |
| Load Capacity — Axial Loads | ◯ | ○ | ◎ | ◎ | ◎ | ◎ | ○ | × | × | ◯ |
| Load Capacity — Combined Loads | ◯ | ○ | ◎ | ◎ | ◎ | ◯ | ○ | × | × | ◯ |
| High Speeds | ◉ | ◎ | ◉ | ◯ | ◎ | ◎ | ◎ | ◉ | ◎ | ◎ |
| High Accuracy | ◉ | | ◉ | | ◉ | ◎ | | ◉ | ◉ | |
| Low Noise and Torque | ◉ | | | | | | | ◎ | | |
| Rigidity | | | | | ◎ | | | ◎ | ◉ | ◎ |
| Angular Misalignment | ◎ | ○ | ○ | ○ | ○ | ○ | ◉ | ◯ | ○ | ◯ |
| Self-Aligning Capability | | | | | | | ☆ | | | |
| Ring Separability | | ☆ | | | | ☆ | | ☆ | ☆ | ☆ |
| Fixed-End Bearing | ☆ | | | ☆ | ☆ | ☆ | ☆ | | | |
| Free-End Bearing | ★ | | | ★ | ★ | ★ | ★ | ☆ | ☆ | |
| Tapered Bore in Inner Ring | | | | | | | ☆ | | ☆ | |
| Remarks | | Two bearings are usually mounted in opposition. | Contact angles of 15°, 25°, 30°, and 40°. Two bearings are usually mounted in opposition. Clearance adjustment is necessary. | | Combination of DF and DT pairs is possible, but use on free-end is not possible. | Contact angle of 35° | | Including N type | Including NNU type | Including NF type |
| Page No. | B005 B055 | B005 B052 | B072 | B074 B108 | B074 | B074 B114 | B120 | B142 | B142 B176 | B142 |

◉ Excellent ◎ Good ◯ Fair ○ Poor × Impossible ⟵ One direction only ⟷ Two directions

☆ Applicable ★ Applicable, but it is necessary to allow shaft contraction/elongation at fitting surfaces of bearings.

| Cylindrical Roller Bearings with Thrust Collars | Needle Roller Bearings | Tapered Roller Bearings | Double-and Multiple-Row Tapered Roller Bearings | Spherical Roller Bearings | Thrust Ball Bearings | Thrust Ball Bearings with Aligning Seat | Double-Direction Angular Contact Thrust Ball Bearings | Thrust Cylindrical Roller Bearings | Thrust Tapered Roller Bearings | Thrust Spherical Roller Bearings | Page No. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ○ | ○ | ○ | ◎ | ◎ | × | × | × | × | × | ○ | – |
| ◯ | × | ○ | ○ | ◯ | ○ | ○ | ○ | ◎ | ◎ | ◎ | – |
| ◯ | × | ○ | ◎ | ○ | × | × | × | × | × | ○ | – |
| ○ | ○ | ◯ | ◯ | ◯ | × | × | ◯ | ○ | ○ | ○ | A022<br>A098 |
| | | ○ | | | ○ | | ◎ | | | | A023<br>A126<br>A151 |
| | | | | | | | | | | | A023 |
| ○ | ○ | ○ | ◎ | | | | ○ | ◎ | ◎ | | A023<br>A192 |
| ◯ | ○ | ◯ | ○ | ◎ | × | ◎ | × | × | × | ◎ | A022 |
| | | | | ☆ | | ☆ | | | | ☆ | A022 |
| ☆ | ☆ | ☆ | ☆ | | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | A023<br>A024 |
| ☆ | | | ☆ | ☆ | | | | | | | A026 to A029 |
| | ☆ | | ★ | ★ | | | | | | | A026 to A029 |
| | | | | ☆ | | | | | | | A150<br>B008<br>B012 |
| Including NUP type | | Two bearings are usually mounted in opposition. Clearance adjustment is necessary. | KH, KV types are also available but use on free-end is impossible. | | | | | Including needle roller thrust bearings | | To be used with oil lubrication | |
| B142 | | B200 | B200<br>B264 | B276 | B314 | B314 | – | B332 | B340 | B350 | |

## 1.3 Contact Angle and Bearing Types

The contact angle ($\alpha$) refers to the angle between a vertical plane of the rotation axis of the bearing and a straight line between the points where the rolling element comes in contact with the inner ring raceway and outer ring raceway.
Radial bearings and thrust bearings are classified depending on the size of the contact angle.

Figure 1.3 shows the relation between contact angle and loading direction on the bearing.

Radial bearing $\alpha$: Less than 45°
(A primarily radial load is applied.)

Thrust bearing $\alpha$: Over 45°
(A primarily axial load is applied.)

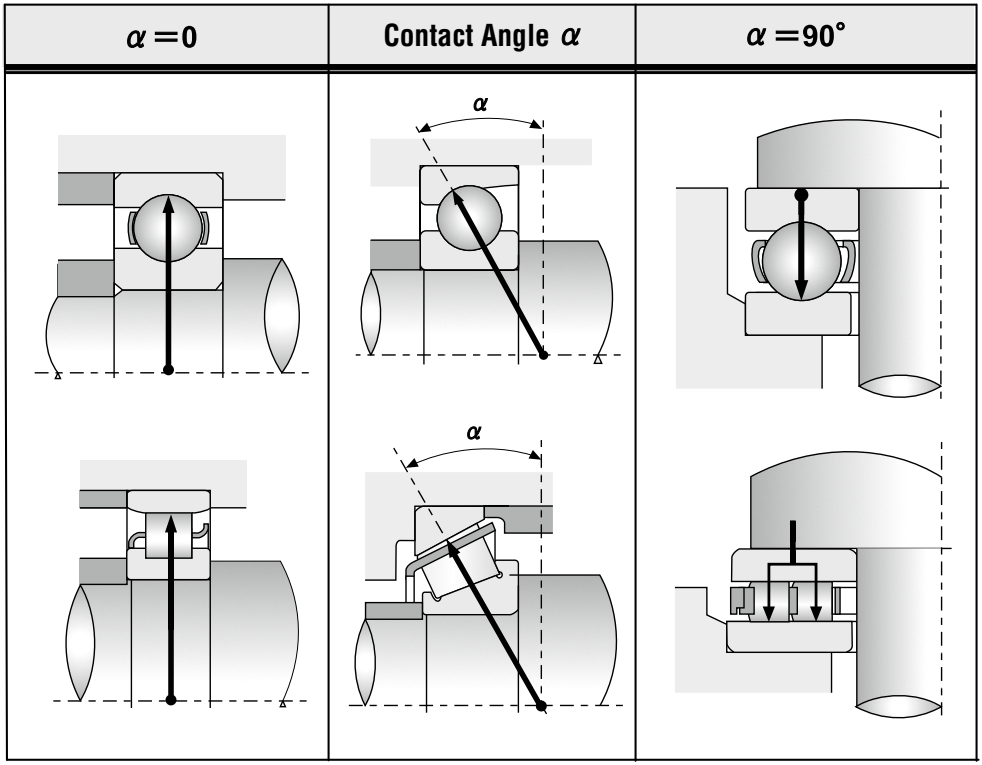



Fig. 1.3 Contact Angle $\alpha$

## 1.4 Types of Load on Bearings

An example deep groove ball bearing is shown.
Figure 1.4 shows the types of the load applied to a rolling bearing.

(a) Radial load
(b) Axial load
(c) Combined radial and axial load
(d) Moment load

It is important to select the optimum bearing type according to the type and magnitude of the load.

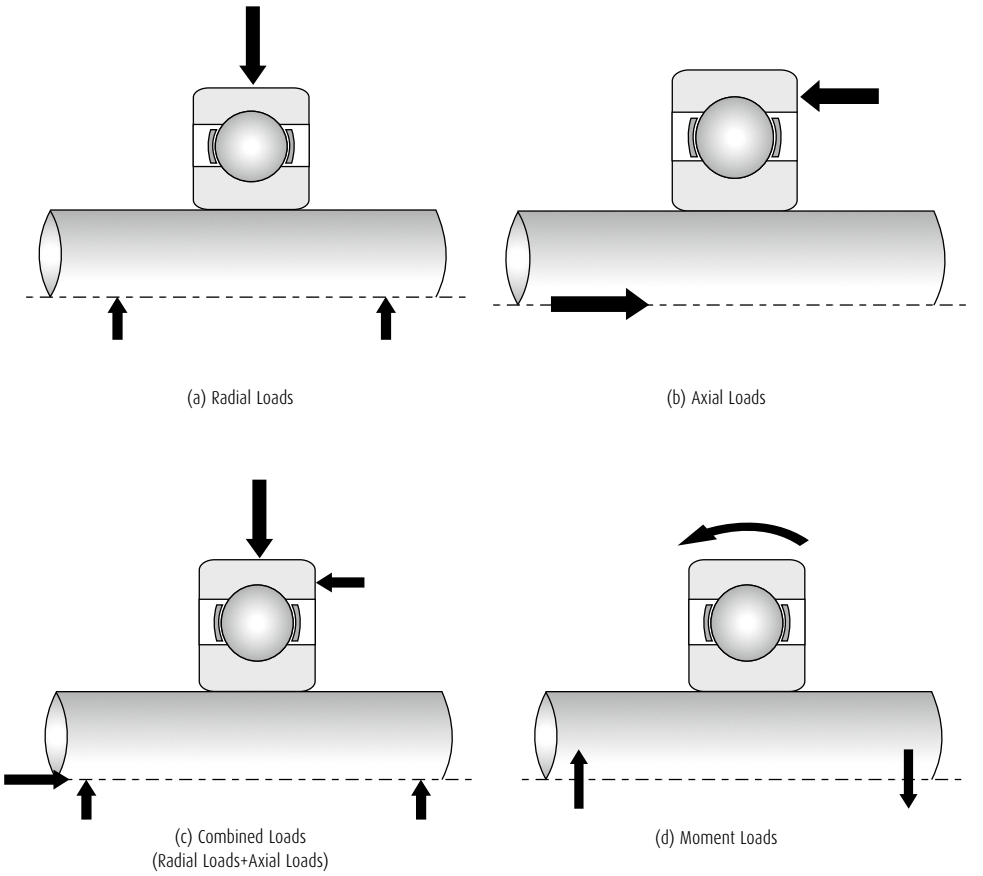



Fig. 1.4 Types of Load


Comparison Between Each Bearing Fatigue Life
NSK
10
8
HTF
STF

## 2. SELECTION OF BEARING TYPES


2.1 Bearing Selection Procedure ..... A 020
2.2 Allowable Bearing Space ..... A 022
2.3 Load Capacity and Bearing Types ..... A 022
2.4 Permissible Speed and Bearing Types ..... A 022
2.5 Misalignment of Inner/Outer Rings and Bearing Types ..... A 022
2.6 Rigidity and Bearing Types ..... A 023
2.7 Noise and Torque of Various Bearing Types ..... A 023
2.8 Running Accuracy and Bearing Types ..... A 023
2.9 Mounting and Dismounting of Various Bearing Types ..... A 023

# 2. Selection of Bearing Types

## 2.1 Bearing Selection Procedure

The number of applications for rolling bearings is almost countless and the operating conditions and environments also vary greatly. In addition, the diversity of operating conditions and bearing requirements continue to grow with the rapid advancement of technology. Therefore, it is necessary to study bearings carefully from many angles to select the best one from the thousands of types and sizes available.

Usually, a bearing type is provisionally chosen considering the operating conditions, mounting arrangement, ease of mounting in the machine, allowable space, cost, availability, and other factors.

Then the size of the bearing is chosen to satisfy the desired life requirement. When doing this, in addition to fatigue life, it is necessary to consider grease life, noise and vibration, wear, and other factors.

There is no fixed procedure for selecting bearings. It is good practice to investigate experience with similar applications and studies relevant to any special requirements for your specific application. When selecting bearings for new machines, unusual operating conditions, or harsh environments, please consult with NSK.

The following diagram (Fig. 2.1) shows an example of the bearing selection procedure.

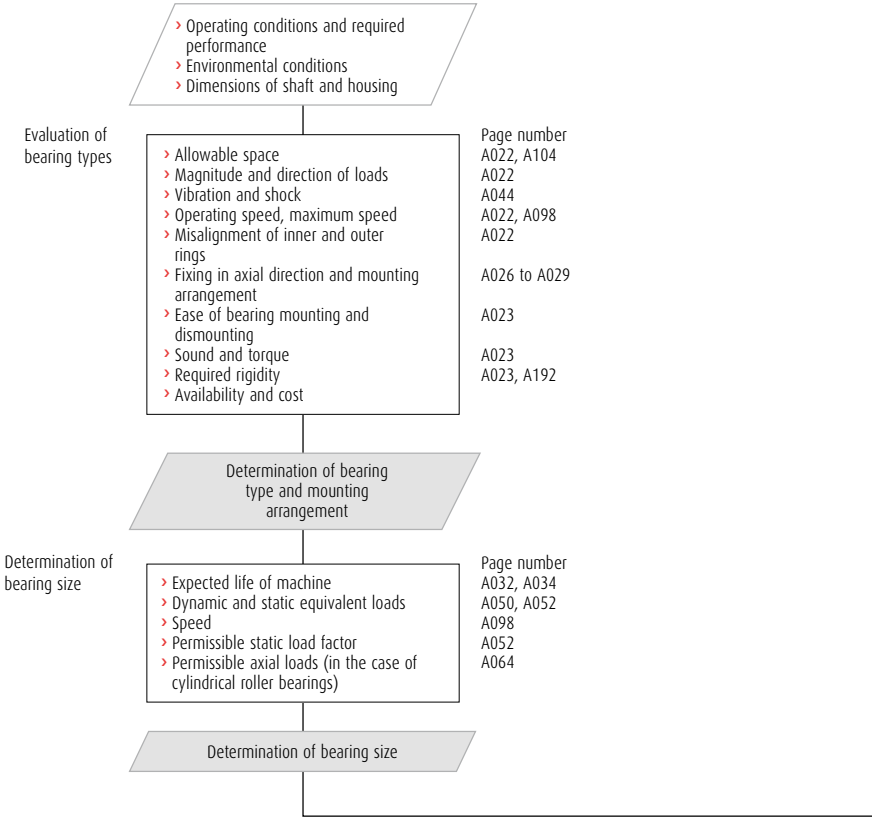
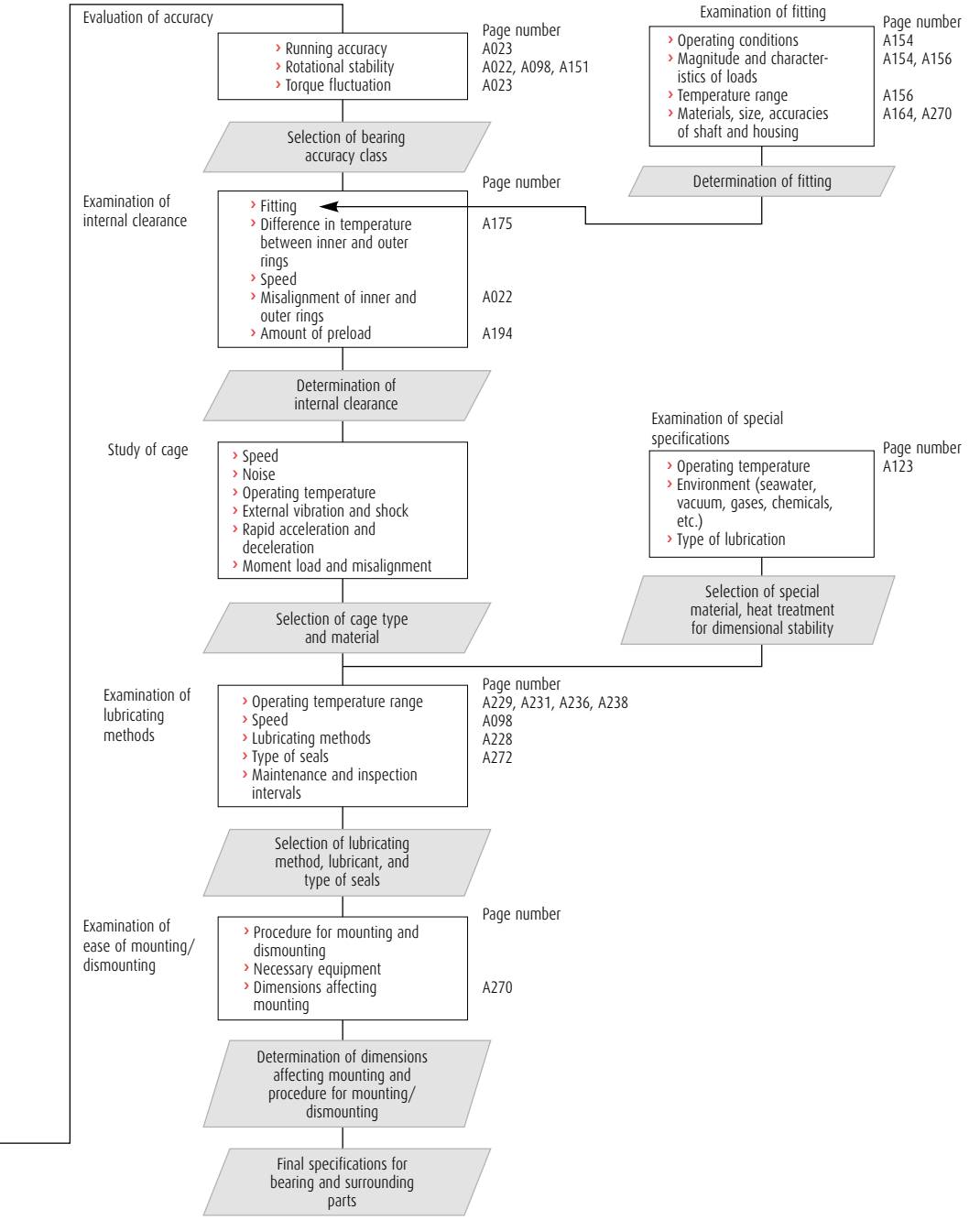



Fig. 2.1 Flow Chart for Selection of Rolling Bearings


Evaluation of accuracy
› Running accuracy
› Rotational stability
› Torque fluctuation
Page number
A023
A022, A098, A151
A023
Selection of bearing accuracy class
Examination of fitting
› Operating conditions
› Magnitude and characteristics of loads
› Temperature range
› Materials, size, accuracies of shaft and housing
Page number
A154
A154, A156
A156
A164, A270
Determination of fitting
Examination of internal clearance
› Fitting
› Difference in temperature between inner and outer rings
› Speed
› Misalignment of inner and outer rings
› Amount of preload
Page number
A175
A022
A194
Determination of internal clearance
Study of cage
› Speed
› Noise
› Operating temperature
› External vibration and shock
› Rapid acceleration and deceleration
› Moment load and misalignment
Examination of special specifications
› Operating temperature
› Environment (seawater, vacuum, gases, chemicals, etc.)
› Type of lubrication
Page number
A123
Selection of special material, heat treatment for dimensional stability
Selection of cage type and material
Examination of lubricating methods
› Operating temperature range
› Speed
› Lubricating methods
› Type of seals
› Maintenance and inspection intervals
Page number
A229, A231, A236, A238
A098
A228
A272
Selection of lubricating method, lubricant, and type of seals
Examination of ease of mounting/dismounting
› Procedure for mounting and dismounting
› Necessary equipment
› Dimensions affecting mounting
Page number
A270
Determination of dimensions affecting mounting and procedure for mounting/dismounting
Final specifications for bearing and surrounding parts

## 2.2 Allowable Bearing Space

The allowable space for a rolling bearing and its adjacent parts is generally limited so the type and size of the bearing must be selected within such limits. In most cases, the shaft diameter is fixed first by the machine design; therefore, the bearing is often selected based on its bore size. For rolling bearings, there are numerous standardized dimension series and types, and the selection of the optimum bearing from among them is necessary. Fig. 2.2 shows the dimension series of radial bearings and corresponding bearing types.

## 2.3 Load Capacity and Bearing Types

The axial load carrying capacity of a bearing is closely related to the radial load capacity (see Page A032) in a manner that depends on the bearing design as shown in Fig. 2.3. This figure makes it clear that when bearings of the same dimension series are compared, roller bearings have a higher load capacity than ball bearings and are superior if shock loads exist.

## 2.4 Permissible Speed and Bearing Types

The maximum speed of rolling bearings varies depending, not only the type of bearing, but also its size, type of cage, loads, lubricating method, heat dissipation, etc. Assuming the common oil bath lubrication method, the bearing types are roughly ranked from higher speed to lower as shown in Fig. 2.4.

## 2.5 Misalignment of Inner/Outer Rings and Bearing Types

Because of deflection of a shaft caused by applied loads, dimensional error of the shaft and housing, and mounting errors, the inner and outer rings are slightly misaligned. The permissible misalignment varies depending on the bearing type and operating conditions, but usually it is a small angle less than 0.0012 radian (4').

When a large misalignment is expected, bearings having a self-aligning capability, such as self-aligning ball bearings, spherical roller bearings, and certain bearing units should be selected (Figs. 2.5 and 2.6).

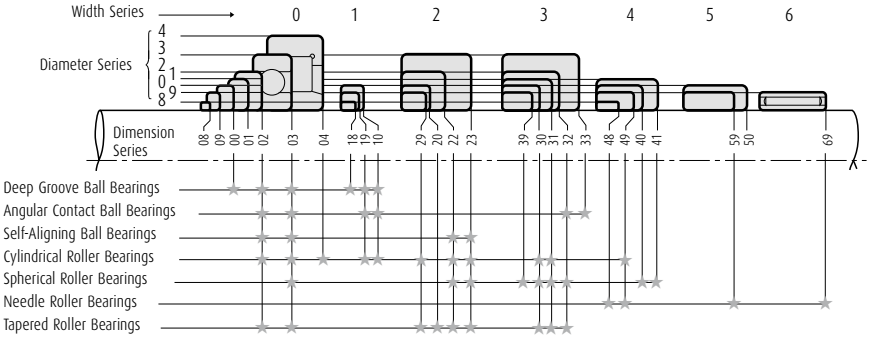
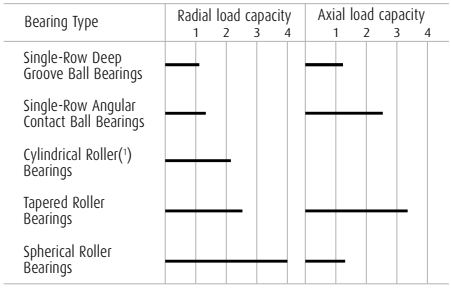



Fig. 2.2 Dimension Series of Radial Bearings




Note(1) The bearings with ribs can take some axial loads.

Fig. 2.3 Relative Load Capacities of Various Bearing Types

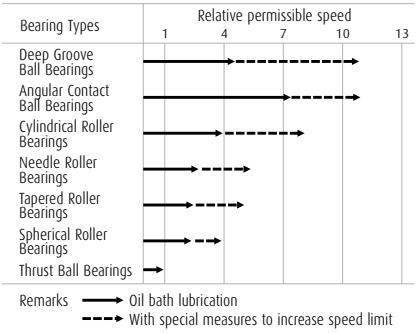



Fig. 2.4 Relative Permissible Speeds of Various Bearing Types

Permissible bearing misalignment is given at the beginning of the dimensional tables for each bearing type.

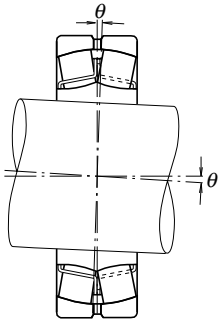



Fig. 2.5 Permissible Misalignment of Spherical Roller Bearings

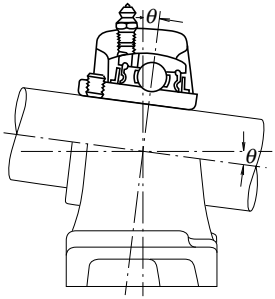



Fig. 2.6 Permissible Misalignment of Ball Bearing Units

| Bearing Types | Highest accuracy specified | Tolerance comparison of inner ring radial runout 1 2 3 4 5 |
|---|---|---|
| Deep Groove Ball Bearings | Class 2 | |
| Angular Contact Ball Bearings | Class 2 | |
| Cylindrical Roller Bearings | Class 2 | |
| Tapered Roller Bearings | Class 4 | |
| Spherical Roller Bearings | Normal | |

Fig. 2.7 Relative Inner Ring Radial Runout of Highest Accuracy Class for Various Bearing Types

## 2.6 Rigidity and Bearing Types

When loads are imposed on a rolling bearing, some elastic deformation occurs in the contact areas between the rolling elements and raceways. The rigidity of the bearing is determined by the ratio of bearing load to the amount of elastic deformation of the inner and outer rings and rolling elements. For the main spindles of machine tools, it is necessary to have high rigidity of the bearings together with the rest of the spindle. Consequently, since roller bearings are deformed less by load, they are more often selected than ball bearings. When extra high rigidity is required, bearings are given a preload, which means that they have a negative clearance. Angular contact ball bearings and tapered roller bearings are often preloaded.

## 2.7 Noise and Torque of Various Bearing Types

Since rolling bearings are manufactured with very high precision, noise and torque are minimal. For deep groove ball bearings and cylindrical roller bearings particularly, the noise level is sometimes specified depending on their purpose. For high precision miniature ball bearings, the starting torque is specified. Deep groove ball bearings are recommended for applications in which low noise and torque are required, such as motors and instruments.

## 2.8 Running Accuracy and Bearing Types

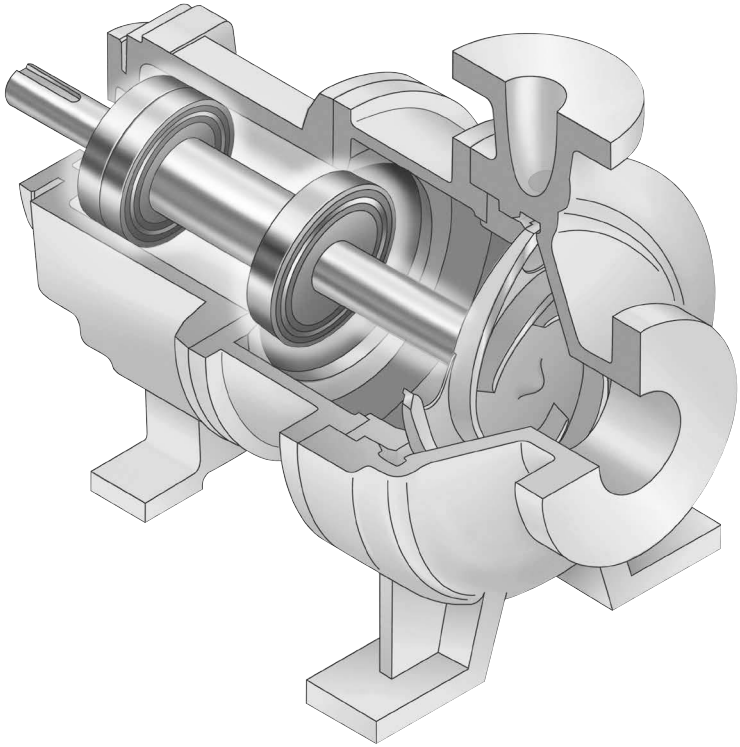
For the main spindles of machine tools that require high running accuracy or high speed applications like superchargers, high precision bearings of Class 5, 4 or 2 are usually used.

The running accuracy of rolling bearings is specified in various ways, and the specified accuracy classes vary depending on the bearing type. A comparison of the inner ring radial runout for the highest running accuracy specified for each bearing type is shown in Fig. 2.7.

For applications requiring high running accuracy, deep groove ball bearings, angular contact ball bearings, and cylindrical roller bearings are most suitable.

## 2.9 Mounting and Dismounting of Various Bearing Types

Separable types of bearings like cylindrical roller bearings, needle roller bearings and tapered roller bearings are convenient for mounting and dismounting. For machines in which bearings are mounted and dismounted rather often for periodic inspection, these types of bearings are recommended. Also, self-aligning ball bearings and spherical roller bearings (small ones) with tapered bores can be mounted and dismounted relatively easily using sleeves.



## 3. SELECTION OF BEARING ARRANGEMENT

3.1 Fixed-End and Free-End Bearings ..... A 026
3.2 Example of Bearing Arrangements ..... A 027

In general, shafts are supported by only two bearings. When considering the bearing mounting arrangement, the following items must be investigated:

(1) Expansion and contraction of the shaft caused by temperature variations.

(2) Ease of bearing mounting and dismounting.

(3) Misalignment of the inner and outer rings caused by deflection of the shaft or mounting error.

(4) Rigidity of the entire system including bearings and preloading method.

(5) Capability to sustain the loads at their proper positions and to transmit them.

## 3.1 Fixed-End and Free-End Bearings

Among the bearings on a shaft, only one can be a "fixed-end" bearing that is used to fix the shaft axially. For this fixed-end bearing, a type which can carry both radial and axial loads must be selected.

Bearings other than the fixed-end one must be "free-end" bearings that carry only radial loads to relieve the shaft's thermal elongation and contraction.

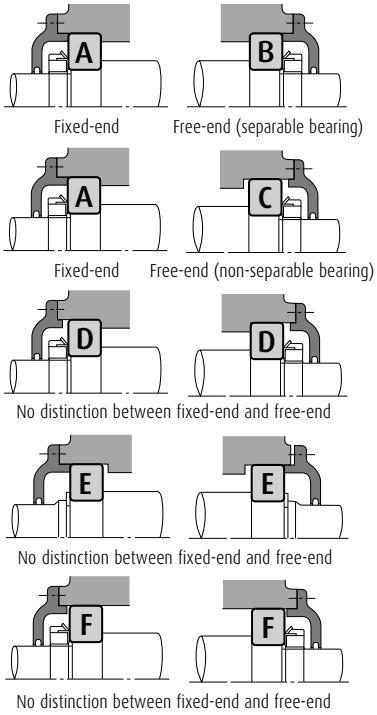



Fig. 3.1 Bearing Mounting Arrangements and Bearing Types

If measures to relieve a shaft's thermal elongation and contraction are insufficient, abnormal axial loads are applied to the bearings, which can cause premature failure.

For free-end bearings, cylindrical roller bearings or needle roller bearings with separable inner and outer rings that are free to move axially (NU, N types, etc.) are recommended. When these types are used, mounting and dismounting are also easier.

When non-separable types are used as free-end bearings, usually the fit between the outer ring and housing is loose to allow axial movement of the running shaft together with the bearing. Sometimes, such elongation is relieved by a loose fitting between the inner ring and shaft.

When the distance between the bearings is short and the influence of the shaft elongation and contraction is negligible, two opposed angular contact ball bearings or tapered roller bearings are used. The axial clearance (possible axial movement) after the mounting is adjusted using nuts or shims.

**BEARING A**
- Deep Groove Ball Bearing
- Matched Angular Contact Ball Bearing
- Double-Row Angular Contact Ball Bearing
- Self-Aligning Ball Bearing
- Cylindrical Roller Bearing with Ribs (NH, NUP types)
- Double-Row Tapered Roller Bearing
- Spherical Roller Bearing

**BEARING B**
- Cylindrical Roller Bearing (NU, N types)
- Needle Roller Bearing (NA type, etc.)

**BEARING C(1)**
- Deep Groove Ball Bearing
- Matched Angular Contact Ball Bearing (back-to-back)
- Double-Row Angular Contact Ball Bearing
- Self-Aligning Ball Bearing
- Double-Row Tapered Roller Bearing (KBE type)
- Spherical Roller Bearing

**BEARING D,E(2)**
- Angular Contact Ball Bearing
- Tapered Roller Bearing
- Magneto Bearing
- Cylindrical Roller Bearing (NJ, NF types)

**BEARING F**
- Deep Groove Ball Bearing
- Self-Aligning Ball Bearing
- Spherical Roller Bearing

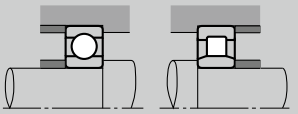
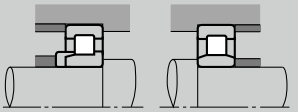
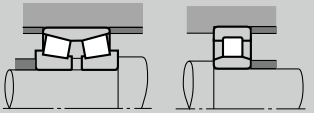
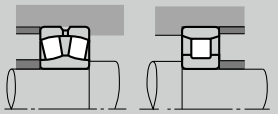
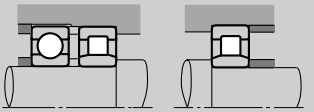
**Notes** (1) In the figure, shaft elongation and contraction are relieved at the outside surface of the outer ring, but sometimes it is done at the bore.
(2) For each type, two bearings are used in opposition.

The distinction between free-end and fixed-end bearings and some possible bearing mounting arrangements for various bearing types are shown in Fig. 3.1.

## 3.2 Examples of Bearing Arrangements

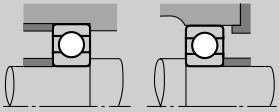
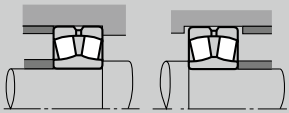
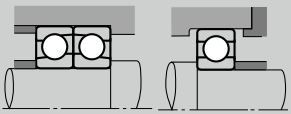
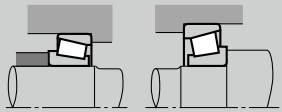
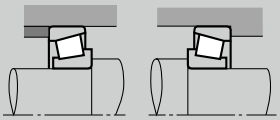
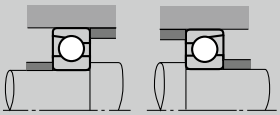
Some representative bearing mounting arrangements considering preload and rigidity of the entire assembly, shaft elongation and contraction, mounting error, etc. are shown in Table 3.1.

### Table 3.1 Representative Bearing Mounting Arrangements and Application Examples

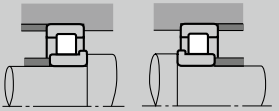
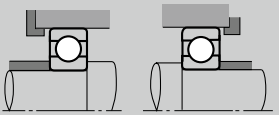
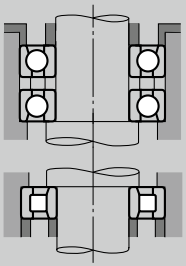
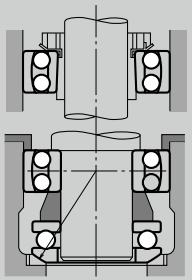
| Bearing Arrangements | | Remarks | Application Examples |
|---|---|---|---|
| Fixed-end | Free-end | | |
|  | | › This is a common arrangement in which abnormal loads are not applied to bearings even if the shaft expands or contracts.<br>› The mounting error is small, this is suitable for high speeds. | Medium size electric motors, blowers |
|  | | › This can withstand heavy loads and shock loads and can take some axial load.<br>› Every type of cylindrical roller bearing is separable. This is helpful when interference is necessary for both the inner and outer rings. | Traction motors for rolling stock |
|  | | › This is used when loads are relatively heavy.<br>› For maximum rigidity of the fixed-end bearing, it is a back-to-back type.<br>› Both the shaft and housing must have high accuracy and the mounting error must be small. | Table rollers for steel mills, main spindles of lathes |
|  | | › This is also suitable when interference is necessary for both the inner and outer rings. Heavy axial loads cannot be applied. | Calender rolls of paper making machines, axles of diesel locomotives |
|  | | › This is suitable for high speeds and heavy radial loads. Moderate axial loads can also be applied.<br>› It is necessary to provide some clearance between the outer ring of the deep groove ball bearing and the housing bore in order to avoid subjecting it to radial loads. | Reduction gears in diesel locomotives |

Continued on next page

## Table 3.1 Representative Bearing Mounting Arrangements and Application Examples

| Bearing Arrangements | | Remarks | Application Examples |
|---|---|---|---|
| Fixed-end | Free-end | | |
|  | | › This is the most common arrangement.<br>› It can sustain not only radial loads, but moderate axial loads also. | Double suction volute pumps, automotive transmissions |
|  | | › This is the most suitable arrangement when there is mounting error or shaft deflection.<br>› It is often used for general and industrial applications in which heavy loads are applied. | Speed reducers, table rollers of steel mills, wheels for overhead travelling cranes |
|  | | › This is suitable when there are rather heavy axial loads in both directions.<br>› Double row angular contact bearings may be used instead of an arrangement of two angular contact ball bearings. | Worm gear reducers |
| When there is no distinction between fixed-end and free-end | | Remarks | Application Examples |
|  <br>Back-to-back mounting<br>  <br>Face-to-face mounting | | › This arrangement is widely used since it can withstand heavy loads and shock loads.<br>› The back-to-back arrangement is especially good when the distance between bearings is short and moment loads are applied.<br>› Face-to-face mounting makes mounting easier when interference is necessary for the inner ring. In general, this arrangement is good when there is mounting error.<br>› To use this arrangement with a preload, attention must be paid to the amount of preload and clearance adjustment. | Pinion shafts of automotive differential gears, automotive front and rear axles, worm gear reducers |
|  <br>Back-to-back mounting | | › This is used at high speeds when radial loads are not so heavy and axial loads are relatively heavy.<br>› It provides good rigidity of the shaft by preloading.<br>› For moment loads, back-to-back mounting is better than face-to-face mounting. | Grinding wheel shafts |

Continued on next page

| When there is no distinction between fixed-end and free-end | Remarks | Application Examples |
|---|---|---|
|  NJ + NJ mounting | › This can withstand heavy loads and shock loads.<br>› It can be used if interference is necessary for both the inner and outer rings.<br>› Care must be taken so the axial clearance doesn't become too small during running.<br>› NF type + NF type mounting is also possible. | Final reduction gears of construction machines |
|  | › Sometimes a spring is used at the side of the outer ring of one bearing. | Small electric motors, small speed reducers, small pumps |
| **Vertical arrangements** | **Remarks** | **Application Examples** |
|  | › Matched angular contact ball bearings are on the fixed end.<br>› Cylindrical roller bearing is on the free end. | Vertical electric motors |
|  | › The spherical center of the self-aligning seat must coincide with that of the self-aligning ball bearing.<br>› The upper bearing is on the free end. | Vertical openers (spinning and weaving machines) |

## 4. SELECTION OF BEARING SIZE


4.1 Bearing Life ..... A 032
4.1.1 Rolling Fatigue Life and Basic Rating Life ..... A 032
4.2 Basic Load Rating and Fatigue Life ..... A 032
4.2.1 Basic Load Rating ..... A 032
4.2.2 Machinery in which Bearings are Used and Projected Life ..... A 034
4.2.3 Selection of Bearing Size Based on Basic Load Rating ..... A 035
4.2.4 Temperature Adjustment for Basic Load Rating ..... A 035
4.2.5 Correction of Basic Rating Life ..... A 037
4.2.6 Life Calculation of Multiple Bearings as a Group ..... A 038
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4.3 Calculation of Bearing Loads ..... A 044
4.3.1 Load Factor ..... A 044
4.3.2 Bearing Loads in Belt or Chain Transmission Applications ..... A 044
4.3.3 Bearing Loads in Gear Transmission Applications ..... A 045
4.3.4 Load Distribution on Bearings ..... A 045
4.3.5 Average of Fluctuating Load ..... A 046
4.3.6 Combination of Rotating and Stationary Loads ..... A 048
4.4 Equivalent Load ..... A 050
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## 4.1 Bearing Life

The various functions required of rolling bearings vary according to the bearing application. These functions must be performed for a prolonged period. Even if bearings are properly mounted and correctly operated, they will eventually fail to perform satisfactorily due to an increase in noise and vibration, loss of running accuracy, deterioration of grease, or fatigue flaking of the rolling surfaces.

Bearing life, in the broad sense of the term, is the period during which bearings continue to operate and to satisfy their required functions. This bearing life may be defined as noise life, abrasion life, grease life, or rolling fatigue life, depending on which one causes loss of bearing service.

Aside from the failure of bearings to function due to natural deterioration, bearings may fail when conditions such as heat-seizure, fracture, scoring of the rings, damage of the seals or the cage, or other damage occurs.

Conditions such as these should not be interpreted as normal bearing failure since they often occur as a result of errors in bearing selection, improper design or manufacture of the bearing surroundings, incorrect mounting, or insufficient maintenance.

### 4.1.1 Rolling Fatigue Life and Basic Rating Life

When rolling bearings are operated under load, the raceways of their inner and outer rings and rolling elements are subjected to repeated cyclic stress. Because of metal fatigue of the rolling contact surfaces of the raceways and rolling elements, scaly particles may separate from the bearing material (Fig. 4.1).
This phenomenon is called "flaking". Rolling fatigue life is represented by the total number of revolutions at which time the bearing surface will start flaking due to stress. This is called fatigue life. As shown in Fig. 4.2, even for seemingly identical bearings, which are of the same type, size, and material and receive the same heat treatment and other processing, the rolling fatigue life varies greatly even under identical operating conditions. This is because the flaking of materials due to fatigue is subject to many other variables. Consequently, "basic rating life", in which rolling fatigue life is treated as a statistical phenomenon, is used in preference to actual rolling fatigue life.

Suppose a number of bearings of the same type are operated individually under the same conditions. After a certain period of time, 10 % of them fail as a result of flaking caused by rolling fatigue. The total number of revolutions at this point is defined as the basic rating life or, if the speed is constant, the basic rating life is often expressed by the total number of operating hours completed when 10 % of the bearings become inoperable due to flaking.

In determining bearing life, basic rating life is often the only factor considered. However, other factors must also be taken into account. For example, the grease life of grease-prelubricated bearings (refer to Section 11, Lubrication, Page A228 can be estimated. Since noise life and abrasion life are judged according to individual standards for different applications, specific values for noise or abrasion life must be determined empirically.

## 4.2 Basic Load Rating and Fatigue Life

### 4.2.1 Basic Load Rating

The basic load rating is defined as the constant load applied on bearings with stationary outer rings that the inner rings can endure for a rating life of one million revolutions ($10^6$ rev). The basic load rating of radial bearings is defined as a central radial load of constant direction and magnitude, while the basic load rating of thrust bearings is defined as an axial load of constant magnitude in the same direction as the central axis. The load ratings are listed under $C_r$ for radial bearings and $C_a$ for thrust bearings in the dimension tables.

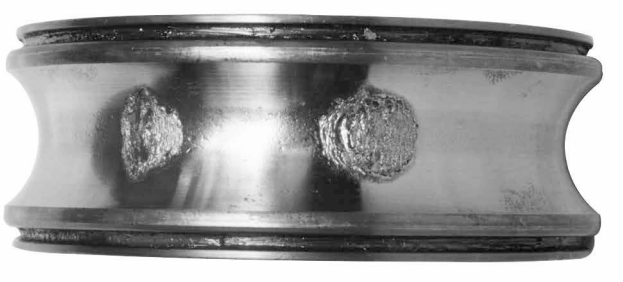

Fig. 4.1 Example of Flaking

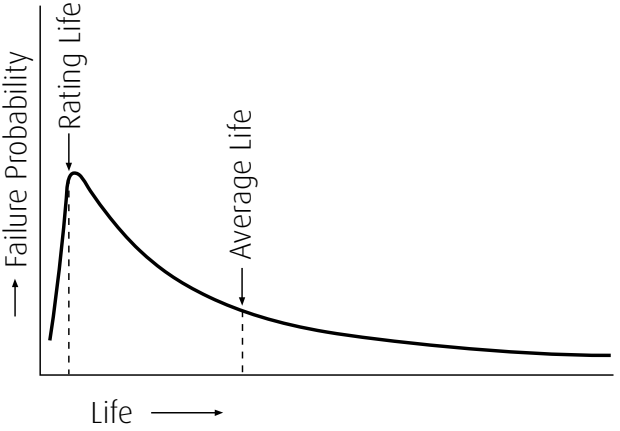


Fig. 4.2 Failure Probability and Bearing Life

### 4.2.2 Machinery in which Bearings are Used and Projected Life

It is not advisable to select bearings with unnecessarily high load ratings, for such bearings may be too large and uneconomical. In addition, the bearing life alone should not be the deciding factor in the selection of bearings. The strength, rigidity, and design of the shaft on which the bearings are to be mounted should also be considered. Bearings are used in a wide range of applications and the design life varies with specific applications and operating conditions. Table 4.1 gives an empirical fatigue life factor derived from customary operating experience for various machines. Also refer to Table 4.2.

**Table 4.1 Fatigue Life Factor $f_h$ for Various Bearing Applications**

| Operating Periods | Fatigue Life Factor $f_h$ | | | | |
|---|---|---|---|---|---|
| | ~3 | 2~4 | 3~5 | 4~7 | 6~ |
| Infrequently used or only for short periods | › Small motors for home appliances like vacuum cleaners and washing machines<br>› Hand power tools | › Agricultural equipment | | | |
| Used only occasionally but reliability is important | | › Motors for home heaters and air conditioners<br>› Construction equipment | › Conveyors<br>› Elevator cable sheaves | | |
| Used intermittently for relatively long periods | › Rolling mill roll necks | › Small motors<br>› Deck cranes<br>› General cargo cranes<br>› Pinion stands<br>› Passenger cars | › Factory motors<br>› Machine tools<br>› Transmissions<br>› Vibrating screens<br>› Crushers | › Crane sheaves<br>› Compressors<br>› Specialized transmissions | |
| Used intermittently for more than eight hours daily | | › Escalators | › Centrifugal separators<br>› Air conditioning equipment<br>› Blowers<br>› Woodworking machines<br>› Large motors<br>› Axle boxes on railway rolling stock | › Mine hoists<br>› Press flywheels<br>› Railway traction motors<br>› Locomotive axle boxes | › Paper making machines |
| Used continuously and high reliability is important | | | | | › Waterworks pumps<br>› Electric power stations<br>› Mine draining pumps |

**Table 4.2 Basic Rating Life, Fatigue Life Factor and Speed Factor**

| Life Parameters | Ball Bearings | Roller Bearings |
|---|---|---|
| Basic Rating Life | $L_h=\frac{10^6}{60n}\left(\frac{C}{P}\right)^3=500f_h^{\,3}$ | $L_h=\frac{10^6}{60n}\left(\frac{C}{P}\right)^{\frac{10}{3}}=500f_h^{\,\frac{10}{3}}$ |
| Fatigue Life Factor | $f_h=f_n\frac{C}{P}$ | $f_h=f_n\frac{C}{P}$ |
| Speed Factor | $f_n=\left(\frac{10^6}{500\times 60n}\right)^{\frac{1}{3}}=(0.03n)^{-\frac{1}{3}}$ | $f_n=\left(\frac{10^6}{500\times 60n}\right)^{\frac{3}{10}}=(0.03n)^{-\frac{3}{10}}$ |

n, $f_n$ ····· Fig. 4.3 (See Page A036), Appendix Table 12 (See Page C018)

$L_h$, $f_h$ ····· Fig. 4.4 (See Page A036), Appendix Table 13 (See Page C019)

### 4.2.3 Selection of Bearing Size Based on Basic Load Rating

The following relation exists between bearing load and basic rating life:

For ball bearings $$L = \left(\frac{C}{P}\right)^3 \quad \text{(4.1)}$$

For roller bearings $$L = \left(\frac{C}{P}\right)^{\frac{10}{3}} \quad \text{(4.2)}$$

where L : Basic rating life ($10^6$ rev)
P : Bearing load (equivalent load) (N), {kgf}
.....(Refer to Page A030)
C : Basic load rating (N), {kgf}
For radial bearings, C is written $C_r$
For thrust bearings, C is written $C_a$

In the case of bearings that run at a constant speed, it is convenient to express the fatigue life in terms of hours. In general, the fatigue life of bearings used in automobiles and other vehicles is given in terms of kilometer.

By designating the basic rating life as $L_h$ (h), bearing speed as n ($min^{-1}$), fatigue life factor as $f_h$, and speed factor as $f_n$, the relations shown in Table 4.2 are obtained.

If the bearing load P and speed n are known, determine a fatigue life factor $f_h$ appropriate for the projected life of the machine and then calculate the basic load rating C by means of the following equation.

$$C = \frac{f_h \cdot P}{f_n} \quad \text{(4.3)}$$

A bearing which satisfies this value of C should then be selected from the bearing tables.

### 4.2.4 Temperature Adjustment for Basic Load Rating

If rolling bearings are used at high temperature, the hardness of the bearing steel decreases. Consequently, the basic load rating, which depends on the physical properties of the material, also decreases. Therefore, the basic load rating should be adjusted for the higher temperature using the following equation:

$$C_t = f_t \cdot C \quad \text{(4.4)}$$

where $C_t$ : Basic load rating after temperature correction (N), {kgf}
$f_t$ : Temperature factor (See Table 4.3)
C : Basic load rating before temperature adjustment (N), {kgf}

If large bearings are used at higher than 120 °C, they must be given special dimensional stability heat treatment to prevent excessive dimensional changes. The basic load rating of bearings given such special dimensional stability heat treatment may become lower than the basic load rating listed in the bearing tables.

**Table 4.3 Temperature Factor $f_t$**

| Bearing Temperature °C | 125 | 150 | 175 | 200 | 250 |
|---|---|---|---|---|---|
| Temperature Factor $f_t$ | 1.00 | 1.00 | 0.95 | 0.90 | 0.75 |

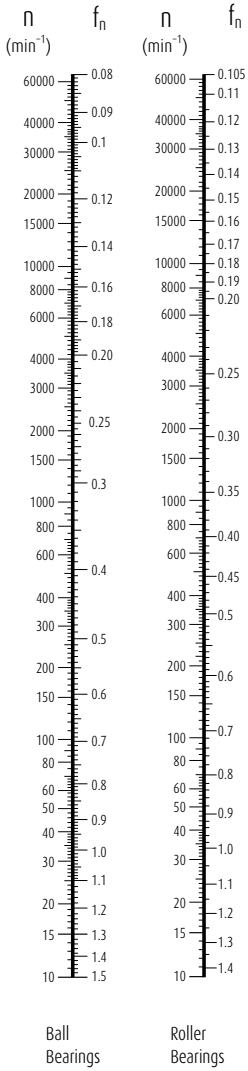


Fig. 4.3 Bearing Speed and Speed Factor

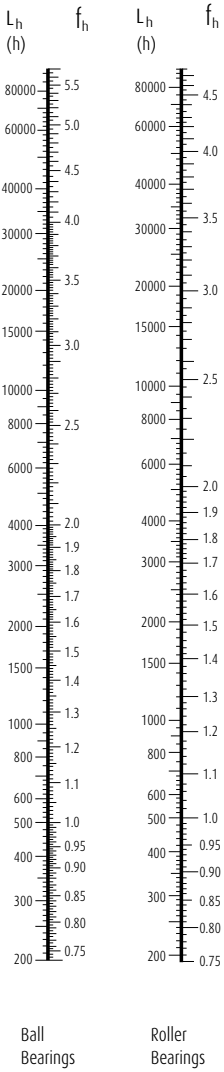


Fig. 4.4 Fatigue Life Factor and Fatigue Life

### 4.2.5 Correction of Basic Rating Life

As described previously, the basic equations for calculating the basic rating life are as follows:

For ball bearings $L_{10} = \left(\frac{C}{P}\right)^3$ ..... (**4.5**)

For roller bearings $L_{10} = \left(\frac{C}{P}\right)^{\frac{10}{3}}$ ..... (**4.6**)

The $L_{10}$ life is defined as the basic rating life with a statistical reliability of 90%. Depending on the machines in which the bearings are used, sometimes a reliability higher than 90% may be required. However, recent improvements in bearing material have greatly extended the fatigue life. In addition, the developent of the Elasto-Hydrodynamic Theory of Lubrication proves that the thickness of the lubricating film in the contact zone between rings and rolling elements greatly influences bearing life. To reflect such improvements in the calculation of fatigue life, the basic rating life is adjusted using the following adjustment factors:

$$L_{na} = a_1\, a_2\, a_3\, L_{10} \quad \text{..... (4.7)}$$

where $L_{na}$ : Adjusted rating life in which reliability, material improvements, lubricating conditions, etc. are considered

$L_{10}$ : Basic rating life with a reliability of 90%

$a_1$ : Life adjustment factor for reliability

$a_2$ : Life adjustment factor for special bearing properties

$a_3$ : Life adjustment factor for operating conditions

The life adjustment factor for reliability, $a_1$, is listed in Table 4.4 for reliabilities higher than 90%.

The life adjustment factor for special bearing properties, $a_2$, is used to reflect improvements in bearing steel.

NSK now uses vacuum degassed bearing steel, and the results of tests by NSK show that life is greatly improved when compared with earlier materials. The basic load ratings $C_r$ and $C_a$ listed in the bearing tables were calculated considering the extended life achieved by improvements in materials and manufacturing techniques. Consequently, when estimating life using Equation (4.7), it is sufficient to assume that is greater than one.

**Table 4.4 Reliability Factor $a_1$**

| Reliability (%) | 90 | 95 | 96 | 97 | 98 | 99 |
|---|---|---|---|---|---|---|
| $a_1$ | 1.00 | 0.62 | 0.53 | 0.44 | 0.33 | 0.21 |

The life adjustment factor for operating conditions $a_3$ is used to adjust for various factors, particularly lubrication. If there is no misalignment between the inner and outer rings and the thickness of the lubricating film in the contact zones of the bearing is sufficient, it is possible for $a_3$ to be greater than one; however, $a_3$ is less than one in the following cases:

- When the viscosity of the lubricant in the contact zones between the raceways and rolling elements is low.
- When the circumferential speed of the rolling elements is very slow.
- When the bearing temperature is high.
- When the lubricant is contaminated by water or foreign matter.
- When misalignment of the inner and outer rings is excessive.

It is difficult to determine the proper value for $a_3$ for specific operating conditions because there are still many unknowns. Since the special bearing property factor $a_2$ is also influenced by the operating conditions, there is a proposal to combine $a_2$ and $a_3$ into one quantity ($a_2 \times a_3$), and not consider them independently. In this case, under normal lubricating and operating conditions, the product ($a_2 \times a_3$) should be assumed equal to one. However, if the viscosity of the lubricant is too low, the value drops to as low as 0.2.

If there is no misalignment and a lubricant with high viscosity is used so sufficient fluid-film thickness is secured, the product of ($a_2 \times a_3$) may be about two.

When selecting a bearing based on the basic load rating, it is best to choose an $a_1$ reliability factor appropriate for the projected use and an empirically determined C/P or $f_h$ value derived from past results for lubrication, temperature, mounting conditions, etc. in similar machines.

The basic rating life equations (4.1), (4.2), (4.5), and (4.6) give satisfactory results for a broad range of bearing loads. However, extra heavy loads may cause detrimental plastic deformation at ball/raceway contact points. When $P_r$ exceeds $C_{or}$ (Basic static load rating) or 0.5 $C_r$, whichever is smaller, for radial bearings or $P_a$ exceeds 0.5 $C_a$ for thrust bearings, please consult NSK to establish the applicablity of the rating fatigue life equations.

### 4.2.6 Life Calculation of Multiple Bearings as a Group

When multiple rolling bearings are used in one machine, the fatigue life of individual bearings can be determined if the load acting on individual bearings is known. Generally, however, the machine becomes inoperative if a bearing in any part fails. It may therefore be necessary in certain cases to know the fatigue life of a group of bearings used in one machine. The fatigue life of the bearings varies greatly and our fatigue life calculation equation

$L = \left(\frac{C}{P}\right)^p$ applies to the 90% life (also called

the rating fatigue life, which is either the gross number of revolution or hours to which 90% of multiple similar bearings operated under similar conditions can reach). In other words, the calculated fatigue life for one bearing has a probability of 90%. Since the endurance probability of a group of multiple bearings for a certain period is a product of the endurance probability of individual bearings for the same period, the rating fatigue life of a group of multiple bearings is not determined solely from the shortest rating fatigue life among the individual bearings. In fact, the group life is much shorter than the life of the bearing with the shortest fatigue life. Assuming the rating fatigue life of individual bearings as $L_1$, $L_2$, $L_3$ ... and the rating fatigue life of the entire group of bearings as L, the below equation is obtained:

$$\frac{1}{L^e} = \frac{1}{L_1^e} + \frac{1}{L_2^e} + \frac{1}{L_3^e} + \cdots \quad (\mathbf{4.8})$$

where, e=1.1 (both for ball and roller bearings)

L of Equation (4.8) can be determined with ease by using Fig. 4.5.

Take the value $L_1$ of Equation (4.8) on the $L_1$ scale and the value of $L_2$ on the $L_2$ scale, connect them with a straight line, and read the intersection with the L scale. In this way, the value $L_A$ of

$$\frac{1}{L_A^e} = \frac{1}{L_1^e} + \frac{1}{L_2^e}$$

is determined. Take this value $L_A$ on the $L_1$ scale and the value $L_3$ on the $L_2$ scale, connect them with a straight line, and read an intersection with the L scale.
In this way, the value L of

$$\frac{1}{L^e} = \frac{1}{L_1^e} + \frac{1}{L_2^e} + \frac{1}{L_3^e}$$

can be determined.

#### Example

Assume that the calculated fatigue life of bearings of automotive front wheels as follows:
280 000 km for inner bearing
320 000 km for outer bearing
Then, the fatigue life of bearings of the wheel can be determined at 160 000 km from Fig. 4.5.
If the fatigue life of the bearing of the right-hand wheel takes this value, the fatigue life of the left-hand wheel will be the same. As a result, the fatigue life of the front wheels as a group will become 85 000 km.

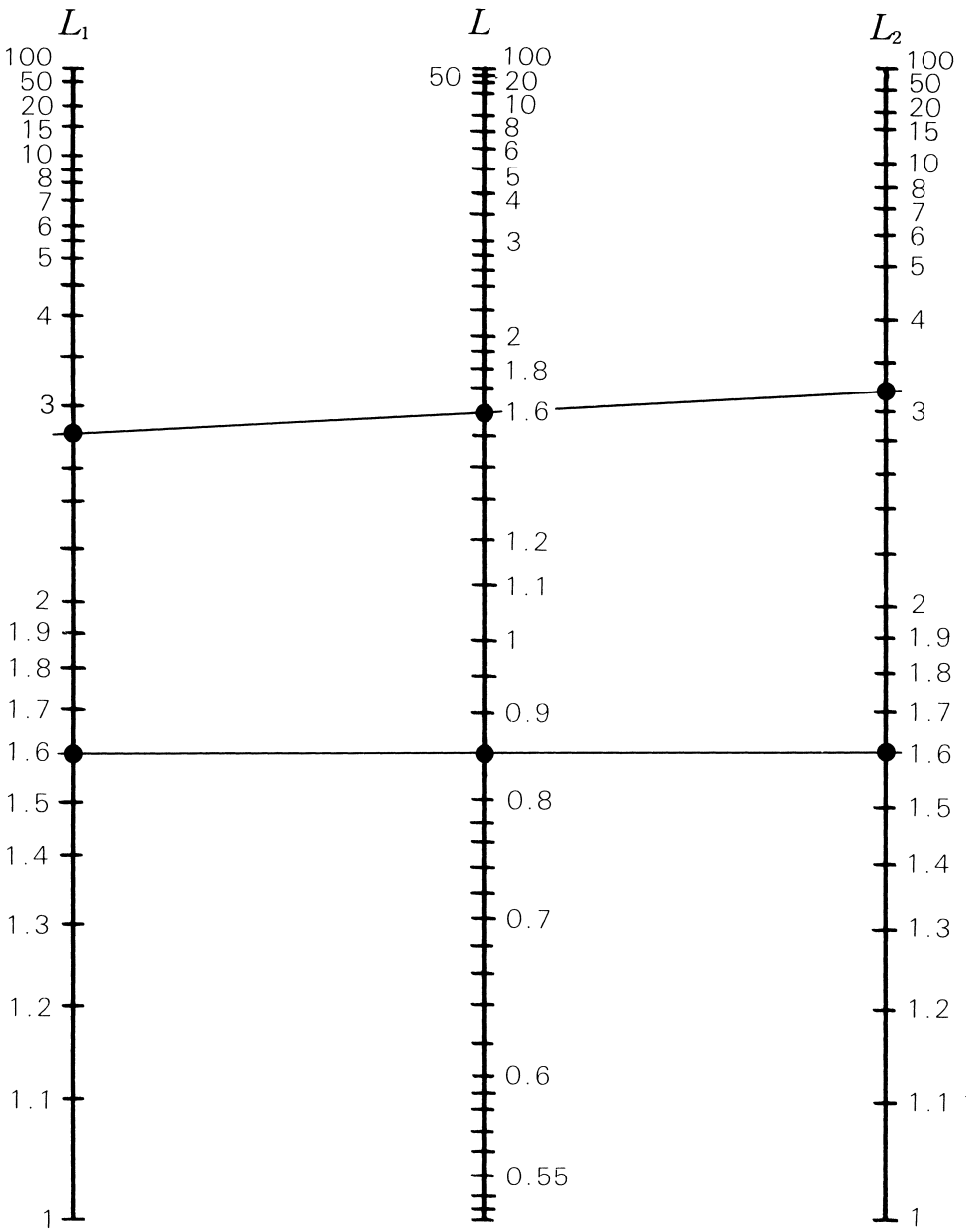


Fig. 4.5 Chart for Life Calculation

### 4.2.7 New Life Theory

Bearing technology has advanced rapidly in recent years, particularly in the areas of dimensional accuracy and material cleanliness. As a result, bearings can now have a longer rolling fatigue life in a cleaner environment, than the life obtained by the traditional ISO life calculation formula. This extended life is partly due to the important advancements in bearing related technology such as lubrication cleanliness and filtration.

The conventional life calculation formula, based on the theories of G. Lundberg and A. Palmgren (L-P theory, hereafter) addresses only sub-surface originated flaking. This is the phenomenon in which cracks initially occur due to dynamic shear stress immediately below the rolling surface then progressively reach the surface in the form of flaking.

$$\ln \frac{1}{S} \propto \frac{\tau_0^c \cdot N^e \cdot V}{Z_0^h} \quad \cdots\cdots (\mathbf{4.9})$$

NSK's new life calculation formula theorizes that rolling fatigue life is the sum total of the combined effects of both sub-surface originated flaking and surface originated flaking occurring simultaneously.

#### NSK New Life Calculation Formula

#### (1) Sub-surface originated flaking

A pre-condition of sub-surface originated flaking of rolling bearings is contact of the rolling elements with the raceway via a sufficient and continuous oil film under clean lubrication conditions.
Fig. 4.6 plots the $L_{10}$ life for each test condition with maximum surface contact pressure ($P_{max}$) and the number of repeated stresses applied on the ordinate and the abscissa, respectively.
In the figure, line $L_{10}$ theoretical is the theoretical line obtained using the conventional life calculation formula.
As maximum surface contact pressure decreases, the actual life line separates from the line created by using conventional theoretical calculation and moves towards longer life.
This separation suggests the presence of fatigue load limit $P_u$ below which no rolling fatigue occurs. This is better illustrated in Fig. 4.7.

$$\ln \frac{1}{S} \propto N^e \int_V \frac{(\tau - \tau_u)^c}{Z_0^h} dV \quad \cdots\cdots (\mathbf{4.10})$$

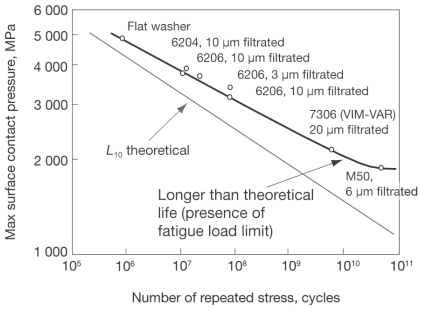


Fig. 4.6 Life Test Result under Clean Lubrication Condition

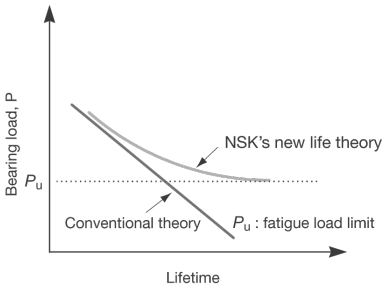


Fig. 4.7 NSK's New Life Theory That Considers Fatigue Limit

#### (2) Surface originated flaking

Under actual bearing operation, the lubricant is often contaminated with foreign objects such as metal chips, burrs, cast sand, etc.
When the foreign particles are mixed in the lubricant, the particles are pressed onto the raceways by the rolling elements and dents occur on the surfaces of the raceways and rolling elements. Stress concentration occurs at the edges of the dents, generating fine cracks, which over time, propagate into flaking of the raceways and rolling elements. As shown in Fig. 4.8, the actual life is shorter than conventional calculated life, under conditions of contaminated lubrication at low max surface pressure. The actual life line separates from the line created by theoretical life calculations and moves towards a shorter life. This result shows that the actual life under contaminated lubrication is further shortened compared to the theoretical life because of the decrease in maximum surface contact pressure.

## Table 4.5 Value of Contamination Coefficient $a_c$

| | Very clean | Clean | Normal | Contaminated | Heavily contaminated |
|---|---|---|---|---|---|
| $a_c$ factor | 1 | 0.8 | 0.5 | 0.4-0.1 | 0.05 |
| Application guide | 10 μm filtration | 10-30 μm filtration | 30-100 μm filtration | Greater than 100 μm filtration or no filtration (oil bath, circulating lubrication, etc.) | No filtration, presence of many fine particles |
| Application examples | Sealed grease lubricated bearing for electrical appliances and information technology equipment, etc. | Sealed grease lubricated bearing for electric motors<br>Sealed grease bearing for railway axle boxes and machine tools, etc. | Normal usage<br>Automotive hub unit bearing, etc. | Bearing for automotive transmission; Bearing for industrial gearbox; Bearing for construction machine, etc. | — |



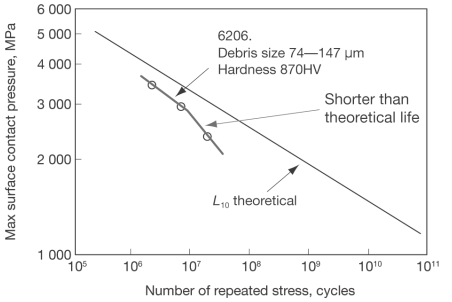


Fig. 4.8 Life Test Result under Contaminated Lubrication Condition

### (3) Calculation of Contamination Coefficient $a_c$

The contamination coefficient in terms of lubrication cleanliness is shown in Table 4.5. Test results on ball and roller bearings with grease lubrication and clean filtration show the life as being a number of times longer than that of the contaminated calculation. Yet when the foreign object is harder than Hv350, hardness becomes a factor and a dent appears on the raceway. Fatigue damage from these dents, can progress to flaking in a short time. Test results on ball and roller bearings under conditions of foreign object contamination show from 1/3 to 1/10 the life when compared with conventionally calculated life.
Based on these test results, the contamination coefficient $a_c$ is classified into five steps for NSK's new life theory.

Therefore, the NSK new life calculation formula considers the trend in the results of the life test under conditions of clean environment and at low load zone. Based on these results, the new life equation is a function of $(P\text{-}P_u)/C$, which is affected by specific lubrication conditions identified by the lubrication parameter. Also, it is assumed that effects of different types and shapes of foreign particles are strongly influenced by the bearing load and lubrication conditions present, and that such a relationship can be expressed as a function of the load parameter. This relationship of the new life calculation formula is defined by $(P\text{-}P_u)/C \cdot 1/a_c$.
Calculation formula for surface originated flaking, based on the above concept, is as follows:

$$\ln\frac{1}{S} \propto N^e \int_V \frac{(\tau-\tau_u)^c}{Z_0^h} dV \times \left\{ \frac{1}{f(a_c, a_L)} - 1 \right\} \cdots\cdots\cdots (\mathbf{4.11})$$

### (4) New life calculation formula $L_{able}$

The following formula, which combines sub-surface originated flaking and surface originated flaking, is proposed as the new life calculation formula.

$$\ln\frac{1}{S} \propto N^{e}\int_{V}\frac{(\tau-\tau_u)^{c}}{Z_0^{h}}dV \times \left\{\frac{1}{f(a_c, a_L)}-1\right\} \quad \cdots\cdots (4.12)$$

$$L_{able} = a_1 \cdot a_{NSK} \cdot L_{10} \quad \cdots\cdots (4.13)$$

### Life Correction Factor $a_{NSK}$

The life correction factor $a_{NSK}$ is the function of lubrication parameter $(P\text{-}P_u)/C \cdot 1/ac$ as shown below:

$$a_{NSK} \propto F\left\{\frac{P-P_u}{C}\cdot\frac{1}{a_c}, a_L\right\} \quad \cdots\cdots (4.14)$$

NSK's new life theory considers the life extending affect of improved material and heat treatment by correcting the contamination factor ac. The theory also utilizes viscosity ratio $\kappa$ ($\kappa = \nu / \nu 1$ where $\nu$ is the operational viscosity and $\nu_1$ the required viscosity) because the lubrication parameter $a_L$ changes with the degree of oil film formation, based on the lubricant and operating temperature. The theory indicates that the better the lubrication conditions (higher $\kappa$) the longer the life.

Figures 4.9 and 4.10 show the diagrams of the correction factor $a_{NSK}$ as a function of the new life calculation formula. Also in this new life calculation formula, point contact and line contact are considered separately for ball and roller bearings respectively.

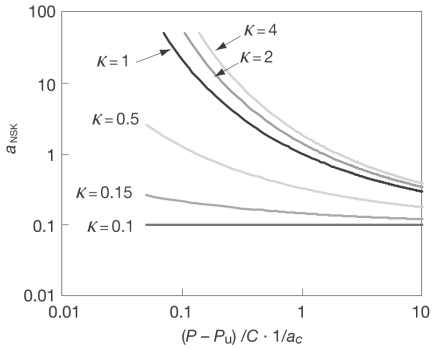


Fig. 4.9 New Life Calculation Diagram for Ball Bearings

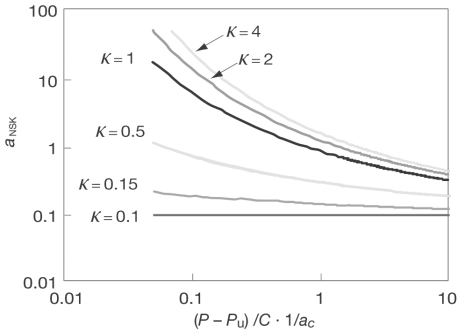


Fig. 4.10 New Life Calculation Diagram for Roller Bearings

**To Access the NSK Calculation Tools**

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## 4.3 Calculation of Bearing Loads

The loads applied on bearings generally include the weight of the body to be supported by the bearings, the weight of the revolving elements themselves, the transmission power of gears and belting, the load produced by the operation of the machine in which the bearings are used, etc. These loads can be theoretically calculated, but some of them are difficult to estimate. Therefore, it becomes necessary to correct the estimated using empirically derived data.

### 4.3.1 Load Factor

When a radial or axial load has been mathematically calculated, the actual load on the bearing may be greater than the calculated load because of vibration and shock present during operation of the machine. The actual load may be calculated using the following equation:

$$\left.\begin{aligned} F_r &= f_w \cdot F_{rc} \\ F_a &= f_w \cdot F_{ac} \end{aligned}\right\} \quad \cdots\cdots (4.15)$$

where $F_r$, $F_a$ : Loads applied on bearing (N), {kgf}

$F_{rc}$, $F_{ac}$ : Theoretically calculated load (N), {kgf}

$f_w$ : Load factor

The values given in Table 4.6 are usually used for the load factor $f_w$.

### 4.3.2 Bearing Loads in Belt or Chain Transmission Applications

The force acting on the pulley or sprocket wheel when power is transmitted by a belt or chain is calculated using the following equations.

$$\left.\begin{aligned} M &= 9\,550\,000\,H / n \ldots. (N \cdot mm) \\ &= 974\,000\,H / n \ldots. \{kgf \cdot mm\} \end{aligned}\right\} \quad \cdots\cdots (4.16)$$

$$P_k = M / r \quad \cdots\cdots (4.17)$$

where $M$ : Torque acting on pulley or sprocket wheel (N · mm), {kgf · mm}

$P_k$ : Effective force transmitted by belt or chain (N), {kgf}

$H$ : Power transmitted (kW)

$n$ : Speed ($min^{-1}$)

$r$ : Effective radius of pulley or sprocket wheel (mm)

When calculating the load on a pulley shaft, the belt tension must be included. Thus, to calculate the actual load $K_b$ in the case of a belt transmission, the effective transmitting power is multiplied by the belt factor $f_b$, which represents the belt tension. The values of the belt factor $f_b$ for different types of belts are shown in Table 4.7.

$$K_b = f_b \cdot P_k \quad \cdots\cdots (4.18)$$

In the case of a chain transmission, the values corresponding to $f_b$ should be 1.25 to 1.5.

**Table 4.6 Values of Load Factor $f_w$**

| Operating Conditions | Typical Applications | $f_w$ |
|---|---|---|
| Smooth operation free from shocks | Electric motors, Machine tools, Air conditioners | 1 to 1.2 |
| Normal operation | Air blowers, Compressors, Elevators, Cranes, Paper making machines | 1.2 to 1.5 |
| Operation accompanied by shock and vibration | Construction equipment, Crushers, Vibrating screens, Rolling mills | 1.5 to 3 |

**Table 4.7 Belt Factor $f_b$**

| Type of Belt | $f_b$ |
|---|---|
| Toothed belts | 1.3 to 2 |
| V belts | 2 to 2.5 |
| Flat belts with tension pulley | 2.5 to 3 |
| Flat belts | 4 to 5 |

### 4.3.3 Bearing Loads in Gear Transmission Applications

The loads imposed on gears in gear transmissions vary according to the type of gears used. In the simplest case of spur gears, the load is calculated as follows:

$$\left.\begin{aligned} M &= 9\,550\,000\,H / n \;....\; (N \cdot mm) \\ &= 974\,000\,H / n \;....\; \{kgf \cdot mm\} \end{aligned}\right\} \cdots\cdots (\mathbf{4.19})$$

$$P_k = M / r \cdots\cdots (\mathbf{4.20})$$

$$S_k = P_k \tan\theta \cdots\cdots (\mathbf{4.21})$$

$$K_c = \sqrt{P_k^2 + S_k^2} = P_k \sec\theta \cdots\cdots (\mathbf{4.22})$$

where $M$ : Torque applied to gear (N · mm), {kgf · mm}

$P_k$ : Tangential force on gear (N), {kgf}

$S_k$ : Radial force on gear (N), {kgf}

$K_c$ : Combined force imposed on gear (N), {kgf}

$H$ : Power transmitted (kW)

$n$ : Speed ($min^{-1}$)

$r$ : Pitch circle radius of drive gear (mm)

$\theta$ : Pressure angle

In addition to the theoretical load calculated above, vibration and shock (which depend on how accurately the gear is finished) should be included using the gear factor $f_g$ by multiplying the theoretically calculated load by this factor.

The values of $f_g$ should generally be those in Table 4.8. When vibration from other sources accompanies gear operation, the actual load is obtained by multiplying the load factor by this gear factor.

**Table 4.8 Values of Gear Factor $f_g$**

| Gear Finish Accuracy | $f_g$ |
|---|---|
| Precision ground gears | 1 ~1.1 |
| Ordinary machined gears | 1.1 ~1.3 |

### 4.3.4 Load Distribution on Bearings

In the simple examples shown in Figs. 4.11 and 4.12. The radial loads on bearings Ⅰ and Ⅱ can be calculated using the following equations:

$$F_{cI} = \frac{b}{c}K \cdots\cdots (\mathbf{4.23})$$

$$F_{cII} = \frac{a}{c}K \cdots\cdots (\mathbf{4.24})$$

where $F_{cI}$ : Radial load applied on bearing Ⅰ (N), {kgf}

$F_{cII}$ : Radial load applied on bearing Ⅱ (N), {kgf}

$K$ : Shaft load (N), {kgf}

When these loads are applied simultaneously, first the radial load for each should be obtained, and then, the sum of the vectors may be calculated according to the load direction.

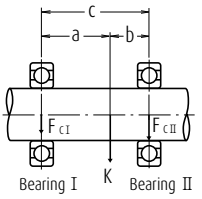



Fig. 4.11 Radial Load Distribution (1)

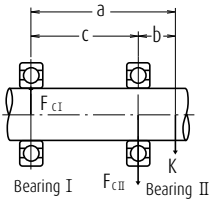



Fig. 4.12 Radial Load Distribution (2)

### 4.3.5 Average of Fluctuating Load

When the load applied on bearings fluctuates, an average load which will yield the same bearing life as the fluctuating load should be calculated.

(1) When the relation between load and rotating speed is divided into the following steps (Fig. 4.13)

Load $F_1$ : Speed $n_1$ ; Operating time $t_1$
Load $F_2$ : Speed $n_2$ ; Operating time $t_2$
⋮ ⋮ ⋮
Load $F_n$ : Speed $n_n$ ; Operating time $t_n$

Then, the average load $F_m$ may be calculated using the following equation:

$$F_m = \sqrt[p]{\frac{F_1^p n_1 t_1 + F_2^p n_2 t_2 + \ldots + F_n^p n_n t_n}{n_1 t_1 + n_2 t_2 + \ldots\ldots + n_n t_n}} \quad \ldots\ldots (\mathbf{4.25})$$

where $F_m$ : Average fluctuating load (N), {kgf}

$p$ = 3 for ball bearings

$p$ = 10/3 for roller bearings

The average speed $n_m$ may be calculated as follows:

$$n_m = \frac{n_1 t_1 + n_2 t_2 + \ldots + n_n t_n}{t_1 + t_2 + \ldots\ldots + t_n} \quad \ldots\ldots (\mathbf{4.26})$$

(2) When the load fluctuates almost linearly (Fig. 4.14), the average load may be calculated as follows:

$$F_m \fallingdotseq \frac{1}{3}(F_{min} + 2F_{max}) \quad \ldots\ldots (\mathbf{4.27})$$

where $F_{min}$ : Minimum value of fluctuating load (N), {kgf}

$F_{max}$ : Maximum value of fluctuating load (N), {kgf}

(3) When the load fluctuation is similar to a sine wave (Fig. 4.15), an approximate value for the average load $F_m$ may be calculated from the following equation:

In the case of Fig. 4.15 (a)

$$F_m \fallingdotseq 0.65\, F_{max} \quad \ldots\ldots (\mathbf{4.28})$$

In the case of Fig. 4.15 (b)

$$F_m \fallingdotseq 0.75\, F_{max} \quad \ldots\ldots (\mathbf{4.29})$$

(4) When both a rotating load and a stationary load are applied (Fig. 4.16).

$F_R$ : Rotating load (N), {kgf}

$F_S$ : Stationary load (N), {kgf}

An approximate value for the average load $F_m$ may be calculated as follows:

a) Where $F_R \geq F_S$

$$F_m \fallingdotseq F_R + 0.3F_S + 0.2\frac{F_S^2}{F_R} \quad \ldots\ldots (\mathbf{4.30})$$

b) Where $F_R < F_S$

$$F_m \fallingdotseq F_S + 0.3F_R + 0.2\frac{F_R^2}{F_S} \quad \ldots\ldots (\mathbf{4.31})$$

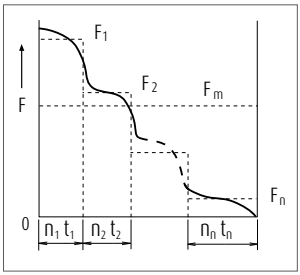



Fig. 4.13 Incremental Load Variation

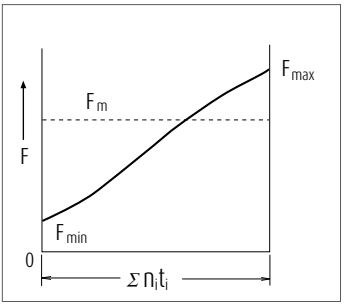
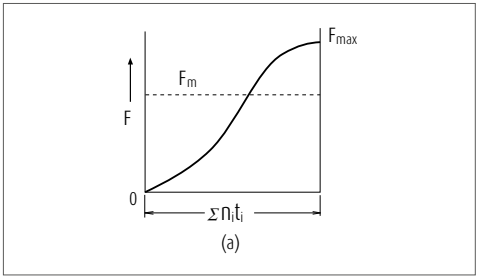



Fig. 4.14 Simple Load Fluctuation





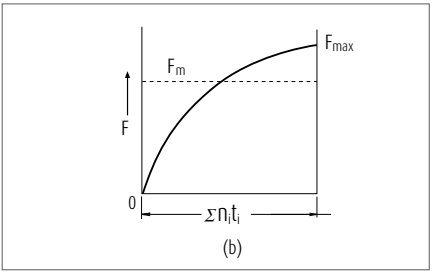




Fig. 4.15 Sinusoidal Load Variation

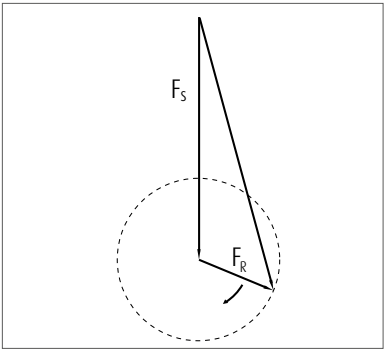



Fig. 4.16 Rotating Load and Stationary Load

### 4.3.6 Combination of Rotating and Stationary Loads

Generally, rotating, static, and indeterminate loads act on a rolling bearing. In certain cases, both the rotating load, which is caused by an unbalanced or a vibration weight, and the stationary load, which is caused by gravity or power transmission, may act simultaneously. The combined mean effective load when the indeterminate load caused by rotating and static loads can be calculated as follows. There are two kinds of combined loads; rotating and stationary which are classified depending on the magnitude of these loads, as shown in Fig. 4.17.

Namely, the combined load becomes a running load with its magnitude changing as shown in Fig. 4.17 (a) if the rotating load is larger than the static load. The combined load becomes an oscillating load with a magnitude changing as shown in Fig. 4.17 (b) if the rotating load is smaller than the stationary load.

In either case, the combined load F is expressed by the following equation:

$$F=\sqrt{F_R^2+F_S^2-2F_RF_S\cos\theta} \quad \cdots\cdots (\mathbf{4.32})$$

where, $F_R$ : Rotating load (N), {kgf}
$F_S$ : Stationary load (N), {kgf}
$\theta$ : Angle defined by rotating and stationary loads

The value F can be approximated by Load Equations (4.33) and (4.34) which vary sinusoidally depending on the magnitude of $F_R$ and $F_S$, that is, in such a manner that $F_R+F_S$ becomes the maximum load $F_{max}$ and $F_R-F_S$ becomes the minimum load $F_{min}$ for $F_R \gg F_S$ or $F_R \ll F_S$.

$F_R \gg F_S$, $F=F_R-F_S\cos\theta$ ····· (**4.33**)
$F_R \ll F_S$, $F=F_S-F_R\cos\theta$ ····· (**4.34**)

The value F can also be approximated by Equations (4.35) and (4.36) when $F_R \fallingdotseq F_S$.

$F_R > F_S$,

$$F = F_R - F_S + 2F_S\sin\frac{\theta}{2} \quad \cdots\cdots (\mathbf{4.35})$$

$F_R < F_S$,

$$F = F_S - F_R + 2F_R\sin\frac{\theta}{2} \quad \cdots\cdots (\mathbf{4.36})$$

Curves of Equations (4.32), (4.33), (4.35), and (4.36) are as shown in Fig. 4.18.

The mean value $F_m$ of the load varying as expressed by Equations (4.33) and (4.34) or (4.35) and (4.36) can be expressed respectively by Equations (4.37) and (4.38) or (4.39) and (4.40).

$F_m=F_{min}+0.65\,(F_{max}-F_{min})$
$F_R \geqq F_S$, $F_m = F_R + 0.3F_S$ ····· (**4.37**)
$F_R \leqq F_S$, $F_m = F_S + 0.3F_R$ ····· (**4.38**)

$F_m=F_{min}+0.75\,(F_{max}-F_{min})$
$F_R \geqq F_S$, $F_m = F_R + 0.5F_S$ ····· (**4.39**)
$F_R \leqq F_S$, $F_m = F_S + 0.5F_R$ ····· (**4.40**)

Generally, as the value F exists somewhere among Equations (4.37), (4.38), (4.39), and (4.40), the factor 0.3 or 0.5 of the second terms of Equations (4.37) and (4.38) as well as (4.39) and (4.40) is assumed to change linearly along with $F_S/F_R$ or $F_R/F_S$. Then, these factors may be expressed as follows:

$$0.3 + 0.2\,\frac{F_S}{F_R},\ 0 \leqq \frac{F_S}{F_R} \leqq 1$$

or $$0.3 + 0.2\,\frac{F_R}{F_S},\ 0 \leqq \frac{F_R}{F_S} \leqq 1$$

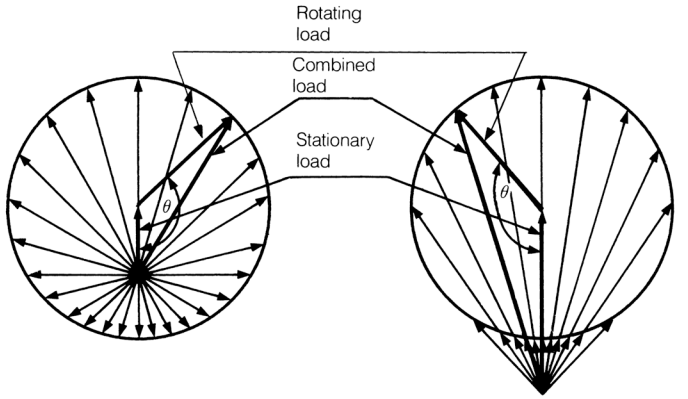
Accordingly, $F_m$ can be expressed by the following equation:

$F_R \geqq F_S$,

$$F_m = F_R + \left(0.3 + 0.2\,\frac{F_S}{F_R}\right) F_S$$
$$= F_R + 0.3F_S + 0.2\,\frac{F_S^2}{F_R} \quad \cdots\cdots (\mathbf{4.41})$$

$F_R \leqq F_S$,

$$F_m = F_S + \left(0.3 + 0.2\,\frac{F_R}{F_S}\right) F_R$$
$$= F_S + 0.3F_R + 0.2\,\frac{F_R^2}{F_S} \quad \cdots\cdots (\mathbf{4.42})$$




(a) Rotating load > stationary load (b) Rotating load < stationary load

Fig. 4.17 Combined Load of Rotating and Stationary Loads

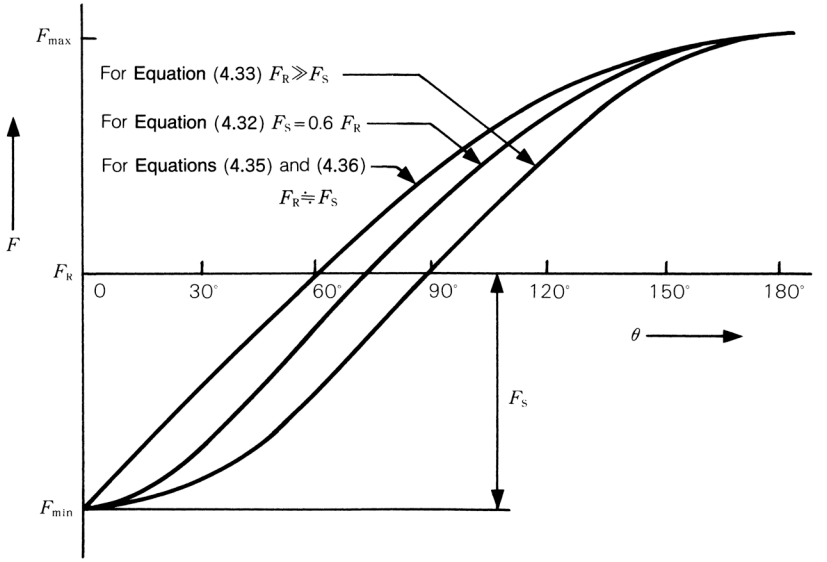



Fig. 4.18 Chart of Combined Loads

## 4.4 Equivalent Load

In some cases, the loads applied on bearings are purely radial or axial loads; however, in most cases, the loads are a combination of both. In addition, such loads usually fluctuate in both magnitude and direction. In such cases, the loads actually applied on bearings cannot be used for bearing life calculations; therefore, a hypothetical load that has a constant magnitude and passes through the center of the bearing, and will give the same bearing life that the bearing would attain under actual conditions of load and rotation should be estimated. Such a hypothetical load is called the equivalent load.

### 4.4.1 Calculation of Equivalent Loads

The equivalent load on radial bearings may be calculated using the following equation:

$$P = XF_r + YF_a \quad \cdots\cdots (\mathbf{4.43})$$

where $P$ : Equivalent Load (N), {kgf}

$F_r$ : Radial load (N), {kgf}

$F_a$ : Axial load (N), {kgf}

$X$ : Radial load factor

$Y$ : Axial load factor

The values of X and Y are listed in the bearing tables.
The equivalent radial load for radial roller bearings with $\alpha = 0°$ is $P = F_r$

In general, thrust ball bearings cannot take radial loads, but spherical thrust roller bearings can take some radial loads. In this case, the equivalent load may be calculated using the following equation:

$$P = F_a + 1.2F_r \quad \cdots\cdots (\mathbf{4.44})$$

where $\dfrac{F_r}{F_a} \leq 0.55$

### 4.4.2 Axial Load Components in Angular Contact Ball Bearings and Tapered Roller Bearings

The effective load center of both angular contact ball bearings and tapered roller bearings is at the point of intersection of the shaft center line and a line representing the load applied on the rolling element by the outer ring as shown in Fig. 4.19. This effective load center for each bearing is listed in the bearing tables.

When radial loads are applied to these types of bearings, a component of load is produced in the axial direction. In order to balance this component load, bearings of the same type are used in pairs, placed face to face or back to back. These axial loads can be calculated using the following equation:

$$F_{ai} = \frac{0.6}{Y} F_r \quad \cdots\cdots (\mathbf{4.45})$$

where $F_{ai}$ : Component load in the axial direction (N), {kgf}

$F_r$ : Radial load (N), {kgf}

$Y$ : Axial load factor

Assume that radial loads $F_{r\,I}$ and $F_{r\,II}$ are applied on bearings I and II (Fig. 4.20) respectively, and an external axial load $F_{ae}$ is applied as shown. If the axial load factors are $Y_I$, $Y_{II}$ and the radial load factor is X, then the equivalent loads $P_I$, $P_{II}$ may be calculated as follows:

where $F_{ae} + \dfrac{0.6}{Y_{II}} F_{r\,II} \geq \dfrac{0.6}{Y_I} F_{r\,I}$

$$\left.\begin{aligned} P_I &= XF_{r\,I} + Y_I \left(F_{ae} + \frac{0.6}{Y_{II}} F_{r\,II}\right) \\ P_{II} &= F_{r\,II} \end{aligned}\right\} \quad \cdots\cdots (\mathbf{4.46})$$

where $F_{ae} + \dfrac{0.6}{Y_{II}} F_{r\,II} < \dfrac{0.6}{Y_I} F_{r\,I}$

$$\left.\begin{aligned} P_I &= F_{r\,I} \\ P_{II} &= XF_{r\,II} + Y_{II} \left(\frac{0.6}{Y_I} F_{r\,I} - F_{ae}\right) \end{aligned}\right\} \quad \cdots\cdots (\mathbf{4.47})$$

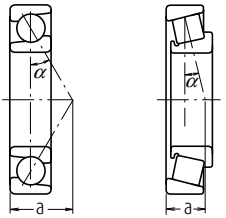



Fig. 4.19 Effective Load Centers

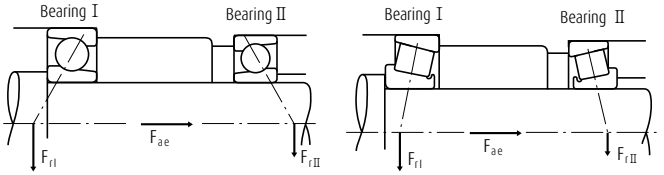



Fig. 4.20 Loads in Opposed Duplex Arrangement

## 4.5 Static Load Ratings and Static Equivalent Loads

### 4.5.1 Static Load Ratings

When subjected to an excessive load or a strong shock load, rolling bearings may incur a local permanent deformation of the rolling elements and permanent deformation of the rolling elements and raceway surface if the elastic limit is exceeded. The non-elastic deformation increases in area and depth as the load increases, and when the load exceeds a certain limit, the smooth running of the bearing is impeded.

The basic static load rating is defined as that static load which produces the following calculated contact stress at the center of the contact area between the rolling element subjected to the maximum stress and the raceway surface.

| | |
|---|---|
| For self-aligning ball bearings | 4 600 MPa {469 kgf/mm$^2$} |
| For other ball bearings | 4 200 MPa {428 kgf/mm$^2$} |
| For roller bearings | 4 000 MPa {408 kgf/mm$^2$} |

In this most heavily stressed contact area, the sum of the permanent deformation of the rolling element and that of the raceway is nearly 0.0001 times the rolling element's diameter. The basic static load rating $C_0$ is written $C_{0r}$ for radial bearings and $C_{0a}$ for thrust bearings in the bearing tables.

In addition, following the modification of the criteria for basic static load rating by ISO, the new $C_0$ values for NSK's ball bearings became about 0.8 to 1.3 times the past values and those for roller bearings about 1.5 to 1.9 times. Consequently, the values of permissible static load factor $f_s$ have also changed, so please pay attention to this.

### 4.5.2 Static Equivalent Loads

The static equivalent load is a hypothetical load that produces a contact stress equal to the above maximum stress under actual conditions, while the bearing is stationary (including very slow rotation or oscillation), in the area of contact between the most heavily stressed rolling element and bearing raceway. The static radial load passing through the bearing center is taken as the static equivalent load for radial bearings, while the static axial load in the direction coinciding with the central axis is taken as the static equivalent load for thrust bearings.

(a) Static equivalent load on radial bearings

The greater of the two values calculated from the following equations should be adopted as the static equivalent load on radial bearings.

$$P_0 = X_0 F_r + Y_0 F_a \quad \cdots\cdots (4.48)$$

$$P_0 = F_r \quad \cdots\cdots (4.49)$$

where $P_0$ : Static equivalent load (N), {kgf}
$F_r$ : Radial load (N), {kgf}
$F_a$ : Axial load (N), {kgf}
$X_0$ : Static radial load factor
$Y_0$ : Static axial load factor

(b) Static equivalent load on thrust bearings

$$P_0 = X_0 F_r + F_a \qquad \alpha \neq 90° \quad \cdots\cdots (4.50)$$

where $P_0$ : Static equivalent load (N), {kgf}
$\alpha$ : Contact angle

When $F_a < X_0 F_r$, this equation becomes less accurate.
The values of $X_0$ and $Y_0$ for Equations (4.47) and (4.49) are listed in the bearing tables.
The static equivalent load for thrust roller bearings with

$\alpha = 90°$ is $P_0 = F_a$

### 4.5.3 Permissible Static Load Factor

The permissible static equivalent load on bearings varies depending on the basic static load rating and also their application and operating conditions.

The permissible static load factor $f_s$ is a safety factor that is applied to the basic static load rating, and it is defined by the ratio in Equation (4.50). The general recommended values of $f_s$ are listed in Table 4.9. Conforming to the modification of the static load rating, the values of $f_s$ were revised, especially for bearings for which the values of $C_0$ were increased, please keep this in mind when selecting bearings.

$$f_s = \frac{C_0}{P_0} \quad \cdots\cdots (4.51)$$

where $C_0$ : Basic static load rating (N), {kgf}
$P_0$ : Static equivalent load (N), {kgf}

For spherical thrust roller bearings, the values of $f_s$ should be greater than 4.

**Table 4.9 Values of Permissible Static Load Factor $f_s$**

| Operating Conditions | Lower Limit of $f_s$ | |
|---|---|---|
| | Ball Bearings | Roller Bearings |
| Low-noise applications | 2 | 3 |
| Bearings subjected to vibration and shock loads | 1.5 | 2 |
| Standard operating conditions | 1 | 1.5 |

## 4.6 Examples of Bearing Calculations

**(Example 1)**

Obtain the fatigue life factor $f_h$ of single-row deep groove ball bearing **6208** when it is used under a radial load $F_r$=2 500 N, {255kgf} and speed n = 900 min$^{-1}$.

The basic load rating $C_r$ of **6208** is 29 100N, {2 970kgf} (Bearing Table, Page B024 Since only a radial load is applied, the equivalent load P may be obtained as follows:

$$P = F_r = 2\ 500\text{N}, \quad \{255\text{kgf}\}$$

Since the speed is n = 900 min$^{-1}$, the speed factor $f_n$ can be obtained from the equation in Table 4.2 or Fig. 4.4 (Page A036), it corresponds approximately to 29 000 hours of service life.

$$f_n = 0.333$$

The fatigue life factor $f_h$, under these conditions, can be calculated as follows:

$$f_h = f_n \frac{C_r}{P} = 0.333 \times \frac{29\ 100}{2\ 500} = 3.88$$

This value is suitable for industrial applications, air conditioners being regularly used, etc., and according to the equation in Table 4.2 or Fig. 4.4 (Page A036), it corresponds approximately to 29 000 hours of service life.

**(Example 2)**

Select a single-row deep groove ball bearing with a bore diameter of 50 mm and outside diameter under 100 mm that satisfies the following conditions:

Radial load $F_r$ = 3 000N, {306kgf}

Speed n = 1 900 min$^{-1}$

Basic rating life $L_h \geq 10\ 000$ h

The fatigue life factor $f_h$ of ball bearings with a rating fatigue life longer than 10 000 hours is $f_h \geq 2.72$.

Because $f_n$ = 0.26, P = $F_r$ = 3 000N, {306kgf}

$$f_h = f_n \frac{C_r}{P} = 0.26 \times \frac{C_r}{3\ 000} \geq 2.72$$

therefore, $C_r \geq 2.72 \times \frac{3\ 000}{0.26} = 31\ 380\text{N}$, {3 200kgf}

Among the data listed in the bearing table on PageB026, **6210** should be selected as one that satisfies the above conditions.

**(Example 3)**

Obtain $C_r$ / P or fatigue life factor $f_h$ when an axial load $F_a$=1 000N, {102kgf} is added to the conditions of (Example 1)

When the radial load $F_r$ and axial load $F_a$ are applied on single-row deep groove ball bearing **6208**, the dynamic equivalent load P should be calculated in accordance with the following procedure.

Obtain the radial load factor X, axial load factor Y and constant e obtainable, depending on the magnitude of $f_o F_a / C_{or}$, from the table above the single-row deep groove ball bearing table.

The basic static load rating $C_{or}$ of ball bearing **6208** is 17 900N, {1 820kgf} (Page B024)

$$f_o F_a / C_{or} = 14.0 \times 1\ 000 / 17\ 900 = 0.782$$

$$e \fallingdotseq 0.26$$

and $F_a / F_r = 1\ 000 / 2\ 500 = 0.4 > e$

$$X = 0.56$$

$$Y = 1.67$$ (the value of Y is obtained by linear interpolation)

Therefore, the dynamic equivalent load P is

$$P = XF_r + YF_a$$

$$= 0.56 \times 2\ 500 + 1.67 \times 1\ 000$$

$$= 3\ 070\text{N}, \quad \{313\text{kgf}\}$$

$$\frac{C_r}{P} = \frac{29\ 100}{3\ 070} = 9.48$$

$$f_h = f_n \frac{C_r}{P} = 0.333 \times \frac{29\ 100}{3\ 070} = 3.16$$

This value of $f_h$ corresponds approximately to 15 800 hours for ball bearings.

**(Example 4)**

Select a spherical roller bearing of series 231 satisfying the following conditions:

Radial load $F_r$ = 45 000N, {4 950kgf}

Axial load $F_a$ = 8 000N, {816kgf}

Speed n = 500 min$^{-1}$

Basic rating life $L_h \geq 30\ 000$ h

The value of the fatigue life factor $f_h$ which makes $L_h \geq 30\ 000$h is bigger than 3.45 from Fig. 4.4 (Page A036).

The dynamic equivalent load P of spherical roller bearings is given by:

when $F_a / F_r \leq e$

$$P = XF_r + YX_a = F_r + Y_3 F_a$$

when $F_a / F_r > e$

$$P = XF_r + YF_a = 0.67 F_r + Y_2 F_a$$

$$F_a / F_r = 8\,000/45\,000 = 0.18$$

We can see in the bearing table that the value of e is about 0.3 and that of $Y_3$ is about 2.2 for bearings of series 231:

Therefore, $P = XF_r + YF_a = F_r + Y_3 F_a$

$= 45\,000 + 2.2 \times 8\,000$

$= 62\,600$N, {6 380kgf}

From the fatigue life factor $f_h$, the basic load rating can be obtained as follows:

$$f_h = f_n \frac{C_r}{P} = 0.444 \times \frac{C_r}{62\,600} \geq 3.45$$

consequently, $C_r \geq 490\,000$N, {50 000kgf}

Among spherical roller bearings of series 231 satisfying this value of $C_r$, the smallest is **23126CE4**

($C_r$ = 505 000N, {51 500kgf})

Once the bearing is determined, substitute the value of $Y_3$ in the equation and obtain the value of P.

$$P = F_r + Y_3 F_a = 45\,000 + 2.4 \times 8\,000$$

$= 64\,200$N, {6 550kgf}

$$L_h = 500 \left( f_n \frac{C_r}{P} \right)^{\frac{10}{3}}$$

$$= 500 \left( 0.444 \times \frac{505\,000}{64\,200} \right)^{\frac{10}{3}}$$

$$= 500 \times 3.49^{\frac{10}{3}} \fallingdotseq 32\,000 \text{ h}$$

**(Example 5)**

Assume that tapered roller bearings **HR30305DJ** and **HR30206J** are used in a back-to-back arrangement as shown in Fig. 4.21, and the distance between the cup back faces is 50 mm.

Calculate the basic rating life of each bearing when beside the radial load $F_r$ = 5 500N, {561kgf},

axial load $F_{ae}$=2 000N, {204kgf} are applied to **HR30305DJ** as shown in Fig. 4.21. The speed is 600 min$^{-1}$.

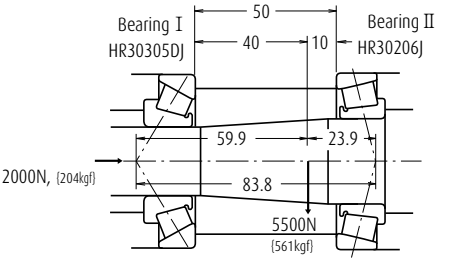



Fig. 4.21 Loads on Tapered Roller Bearings

To distribute the radial load $F_r$ on bearings I and II, the effective load centers must be located for tapered roller bearings. Obtain the effective load center a for bearings I and II from the bearing table, then obtain the relative position of the radial load $F_r$ and effective load centers. The result will be as shown in Fig. 4.21. Consequently, the radial load applied on bearings I (**HR30305DJ**) and II (**HR30206J**) can be obtained from the following equations:

$$F_{rI} = 5\,500 \times \frac{23.9}{83.8} = 1\,569\text{N}, \quad \{160\text{kgf}\}$$

$$F_{rII} = 5\,500 \times \frac{59.9}{83.8} = 3\,931\text{N}, \quad \{401\text{kgf}\}$$

From the data in the bearing table, the following values are obtained;

| Bearings | Basic dynamic load rating $C_r$ (N) {kgf} | Axial load factor $Y_1$ | Constant e |
|---|---|---|---|
| Bearing I (HR30305DJ) | 38 000 {3 900} | $Y_I = 0.73$ | 0.83 |
| Bearing II (HR30206J) | 43 000 {4 400} | $Y_{II} = 1.6$ | 0.38 |

When radial loads are applied on tapered roller bearings, an axial load component is produced, which must be considered to obtain the dynamic equivalent radial load (Refer to Paragraph 4.4.2, Page A051).

$$F_{ae} + \frac{0.6}{Y_{II}} F_{rII} = 2\,000 + \frac{0.6}{1.6} \times 3\,931$$

$$= 3\,474\text{N}, \quad \{354\text{kgf}\}$$

$$\frac{0.6}{Y_I} F_{rI} = \frac{0.6}{0.73} \times 1\,569 = 1\,290\text{N}, \quad \{132\text{kgf}\}$$

Therefore, with this bearing arrangement, the axial load $F_{ae} + \frac{0.6}{Y_{II}} F_{rII}$ is applied on bearing I but not on bearing II.

For bearing I

$F_{rI} = 1\,569\text{N}$, {160kgf}

$F_{aI} = 3\,474\text{N}$, {354kgf}

since $F_{aI} / F_{rI} = 2.2 > e = 0.83$

the dynamic equivalent load $P_I = XF_{rI} + Y_I F_{aI}$

$= 0.4 \times 1\,569 + 0.73 \times 3\,474$

$= 3\,164\text{N}$, {323kgf}

The fatigue life factor $f_h = f_n \frac{C_r}{P_I}$

$$= \frac{0.42 \times 38\,000}{3\,164} = 5.04$$

and the rating fatigue life $L_h = 500 \times 5.04^{\frac{10}{3}} = 109\,750$ h

For bearing II

since $F_{rII} = 3\,931\text{N}$, {401kgf}, $F_{aII} = 0$

the dynamic equivalent load

$P_{II} = F_{rII} = 3\,931\text{N}$, {401kgf}

the fatigue life factor

$$f_h = f_n \frac{C_r}{P_{II}} = \frac{0.42 \times 43\,000}{3\,931} = 4.59$$

and the rating fatigue life $L_h = 500 \times 4.59^{\frac{10}{3}} = 80\,400$ h are obtained.

**Remark** For face-to-face arrangements (DF type), please contact NSK.

**(Example 6)**

Select a bearing for a speed reducer under the following conditions:

Operating conditions

Radial load $F_r = 245\,000\text{N}$, {25 000kgf}
Axial load $F_a = 49\,000\text{N}$, {5 000kgf}
Speed $n = 500\ \text{min}^{-1}$

Size limitation

Shaft diameter: 300 mm
Bore of housing: Less than 500 mm

In this application, heavy loads, shocks, and shaft deflection are expected; therefore, spherical roller bearings are appropriate.

The following spherical roller bearings satisfy the above size limitation (refer to Page B302)

| d | D | B | Bearing No. | Basic dynamic load rating $C_r$ (N) | Constant e | Factor $Y_3$ |
|---|---|---|---|---|---|---|
| 300 | 420 | 90 | **23960 CAE4** | 1 540 000 | 0.19 | 3.5 |
| | 460 | 118 | **23060 CAE4** | 2 400 000 | 0.24 | 2.8 |
| | 460 | 160 | **24060 CAE4** | 2 890 000 | 0.32 | 2.1 |
| | 500 | 160 | **23160 CAE4** | 3 350 000 | 0.31 | 2.2 |
| | 500 | 200 | **24160 CAE4** | 3 900 000 | 0.38 | 1.8 |

since $F_a / F_r = 0.20 < e$

the dynamic equivalent load P is

$P = F_r + Y_3 F_a$

Judging from the fatigue life factor $f_h$ in Table 4.1 and examples of applications (refer to Page A034), a value of $f_h$, between 3 and 5 seems appropriate.

$$f_h = f_n \frac{C_r}{P} = \frac{0.444\ C_r}{F_r + Y_3 F_a} = 3 \text{ to } 5$$

Assuming that $Y_3 = 2.1$, then the necessary basic load rating $C_r$ can be obtained

$$C_r = \frac{(F_r + Y_3 F_a) \times (3 \text{ to } 5)}{0.444}$$

$$= \frac{(245\,000 + 2.1 \times 49\,000) \times (3 \text{ to } 5)}{0.444}$$

$= 2\,350\,000$ to $3\,900\,000$ N,
{240 000 to 400 000 kgf}

The bearings which satisfy this range are **23060CAE4**, **24060CAE4**, **23160CAE4**, and **24160CAE4**.

## 4.7 Bearing Type and Allowable Axial Load

### 4.7.1 Change of Contact Angle of Radial Ball Bearings and Allowable Axial Load

#### (1) Change of Contact Angle Due to Axial Load

When an axial load acts on a radial ball bearing, the rolling element and raceway develop elastic deformation, resulting in an increase in the contact angle and width. When heat generation or seizure has occurred, the bearing should be disassembled and checked for running trace to discover whether there has been a change in the contact angle during operation. In this way, it is possible to see whether an abnormal axial load has been sustained.
The relation shown below can be established among the axial load $F_a$ on a bearing, the load of rolling element Q, and the contact angle a when the load is applied. (See Equations (9.7), (9.8), and (9.10) in Section 9.6.2)

$$F_a = Z\,Q\sin\alpha = K\,Z\,D_w^{\,2}\left\{\sqrt{(\sin\alpha_0+h)^2+\cos^2\alpha_0}-1\right\}^{3/2}\cdot\sin\alpha \quad \cdots\cdots (\mathbf{4.52})$$

$$\alpha = \sin^{-1}\frac{\sin\alpha_0 + h}{\sqrt{(\sin\alpha_0+h)^2+\cos^2\alpha_0}} \quad \cdots\cdots (\mathbf{4.53})$$

$$h = \frac{\delta_a}{m_0} = \frac{\delta_a}{r_e+r_i-D_w}$$

Namely, $\delta_a$ is the change in Equation (4.52) to determine $\alpha$ corresponding to the contact angle known from observation of the raceway. Thus, $\delta_a$ and $\alpha$ are introduced into Equation (4.51) to estimate the axial load $F_a$ acting on the bearing. As specifications of a bearing are necessary in this case for calculation, the contact angle $\alpha$ was approximated from the axial load. The basic static load rating $C_{0r}$ is expressed by Equation (4.53) for the case of a single row radial ball bearing.

$$C_{0r} = f_0\,Z\,D_w^{\,2}\cos\alpha_0 \quad \cdots\cdots (\mathbf{4.54})$$

where, $f_0$: Factor determined from the shape of bearing components and applicable stress level

Equation (4.54) is determined from Equations (4.51) and (4.53):

$$\frac{f_0}{C_{0r}}F_a = A\,F_a = K\left\{\sqrt{(\sin\alpha_0 + h)^2 + \cos^2\alpha_0}-1\right\}^{3/2}\cdot\frac{\sin\alpha}{\cos\alpha_0} \quad \cdots\cdots (\mathbf{4.55})$$

where, K: Constant determined from material and design of bearing

In other words, "h" is assumed and $\alpha$ is determined from Equation (4.52). Then "h" and $\alpha$ are introduced into Equation (4.54) to determine $A\,F_a$. This relation is used to show the value A for each bore number of an angular contact ball bearing in Table 4.14. The relationship between $A\,F_a$ and $\alpha$ is shown in Fig. 4.22.

### Example 1

Change in the contact angle is calculated when the pure axial load $F_a$ = 35.0 kN (50% of basic static load rating) is applied to an angular contact ball bearing 7215C.
A = 0.212 is calculated from Table 4.10 and
$A\,F_a = 0.212 \times 35.0 = 7.42$ and $\alpha \fallingdotseq 26°$ are obtained from Fig. 4.22. An initial contact angle of 15° has changed to 26° under the axial load.

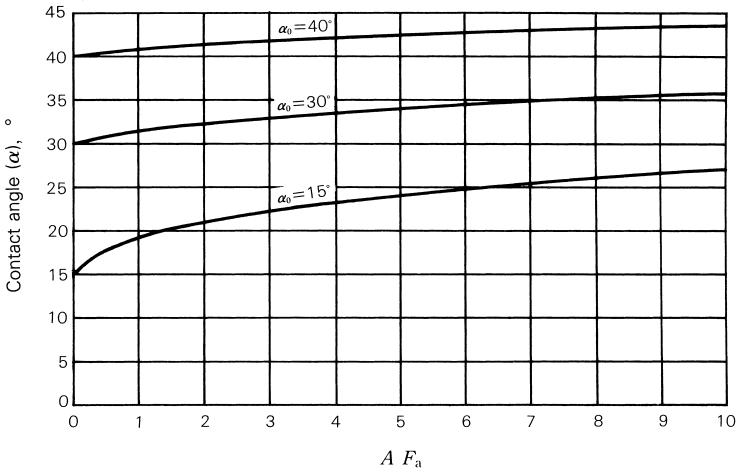



Fig. 4.22 Change of the Contact Angle of Angular Contact Ball Bearing under Axial Load

## Table 4.10 Constant A Value of Angular Contact Ball Bearing

Units: $kN^{-1}$

| Bearing bore No. | Bearing series 70 | | | Bearing series 72 | | | Bearing series 73 | | |
|---|---|---|---|---|---|---|---|---|---|
| | 15° | 30° | 40° | 15° | 30° | 40° | 15° | 30° | 40° |
| 05 | 1.97 | 2.05 | 2.31 | 1.26 | 1.41 | 1.59 | 0.838 | 0.850 | 0.961 |
| 06 | 1.45 | 1.51 | 1.83 | 0.878 | 0.979 | 1.11 | 0.642 | 0.651 | 0.736 |
| 07 | 1.10 | 1.15 | 1.38 | 0.699 | 0.719 | 0.813 | 0.517 | 0.528 | 0.597 |
| 08 | 0.966 | 1.02 | 1.22 | 0.562 | 0.582 | 0.658 | 0.414 | 0.423 | 0.478 |
| 09 | 0.799 | 0.842 | 1.01 | 0.494 | 0.511 | 0.578 | 0.309 | 0.316 | 0.357 |
| 10 | 0.715 | 0.757 | 0.901 | 0.458 | 0.477 | 0.540 | 0.259 | 0.265 | 0.300 |
| 11 | 0.540 | 0.571 | 0.681 | 0.362 | 0.377 | 0.426 | 0.221 | 0.226 | 0.255 |
| 12 | 0.512 | 0.542 | 0.645 | 0.293 | 0.305 | 0.345 | 0.191 | 0.195 | 0.220 |
| 13 | 0.463 | 0.493 | 0.584 | 0.248 | 0.260 | 0.294 | 0.166 | 0.170 | 0.192 |
| 14 | 0.365 | 0.388 | 0.460 | 0.226 | 0.237 | 0.268 | 0.146 | 0.149 | 0.169 |
| 15 | 0.348 | 0.370 | – | 0.212 | 0.237 | 0.268 | 0.129 | 0.132 | 0.149 |
| 16 | 0.284 | 0.302 | 0.358 | 0.190 | 0.199 | 0.225 | 0.115 | 0.118 | 0.133 |
| 17 | 0.271 | 0.288 | 0.341 | 0.162 | 0.169 | 0.192 | 0.103 | 0.106 | 0.120 |
| 18 | 0.228 | 0.242 | 0.287 | 0.140 | 0.146 | 0.165 | 0.0934 | 0.0955 | 0.108 |
| 19 | 0.217 | 0.242 | 0.273 | 0.130 | 0.136 | 0.153 | 0.0847 | 0.0866 | 0.0979 |
| 20 | 0.207 | 0.231 | 0.261 | 0.115 | 0.119 | 0.134 | 0.0647 | 0.0722 | 0.0816 |

Values for a deep groove ball bearing are similarly shown in Table 4.11 and Fig. 4.23.

### Example 2

Change in the contact angle is calculated when the pure axial load $F_a$=24.75 kN (50% of the basic static load rating) is applied to the deep groove ball bearing 6215. Note here that the radial internal clearance is calculated as the median (0.020 mm) of the normal clearance.

The initial contact angle 10° is obtained from Fig. 3, Page B015. A=0.303 is determined from Table 4.11 and A $F_a$ = 0.303 × 24.75≒7.5 and a≒24° from Fig. 4.23.

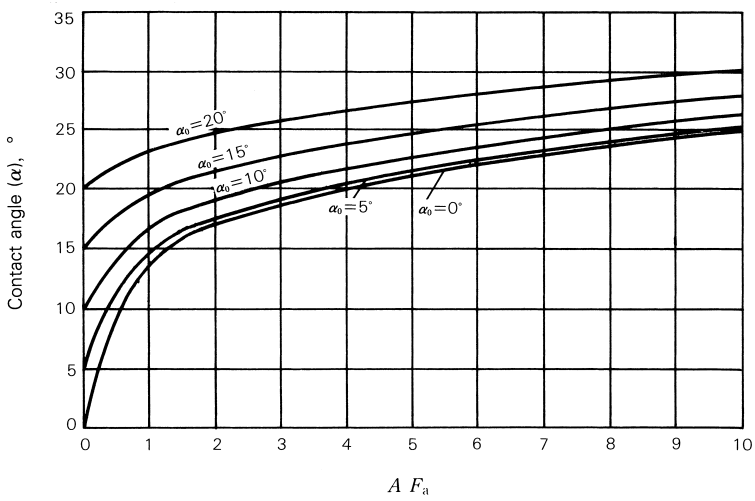



Fig. 4.23 Change in the Contact Angle of the Deep Groove Ball Bearing under Axial Load

## Table 4.11 Constant A Value of Angular Contact Ball Bearing

Units: $kN^{-1}$

| Bearing bore No. | Bearing series 62 | | | | |
|---|---|---|---|---|---|
| | 0° | 5° | 10° | 15° | 20° |
| 05 | 1.76 | 1.77 | 1.79 | 1.83 | 1.88 |
| 06 | 1.22 | 1.23 | 1.24 | 1.27 | 1.30 |
| 07 | 0.900 | 0.903 | 0.914 | 0.932 | 0.958 |
| 08 | 0.784 | 0.787 | 0.796 | 0.811 | 0.834 |
| 09 | 0.705 | 0.708 | 0.716 | 0.730 | 0.751 |
| 10 | 0.620 | 0.622 | 0.630 | 0.642 | 0.660 |
| 11 | 0.490 | 0.492 | 0.497 | 0.507 | 0.521 |
| 12 | 0.397 | 0.398 | 0.403 | 0.411 | 0.422 |
| 13 | 0.360 | 0.361 | 0.365 | 0.373 | 0.383 |
| 14 | 0.328 | 0.329 | 0.333 | 0.340 | 0.349 |
| 15 | 0.298 | 0.299 | 0.303 | 0.309 | 0.317 |
| 16 | 0.276 | 0.277 | 0.280 | 0.285 | 0.293 |
| 17 | 0.235 | 0.236 | 0.238 | 0.243 | 0.250 |
| 18 | 0.202 | 0.203 | 0.206 | 0.210 | 0.215 |
| 19 | 0.176 | 0.177 | 0.179 | 0.183 | 0.188 |
| 20 | 0.155 | 0.156 | 0.157 | 0.160 | 0.165 |

### (2) Allowable Axial Load for a Deep Groove Ball Bearing

The allowable axial load here means the limit load at which a contact ellipse is generated between the ball and raceway due to a change in the contact angle when a radial bearing, which is under an axial load, rides over the shoulder of the raceway groove. This is different from the limit value of a static equivalent load $P_0$ which is determined from the basic static load rating $C_{0r}$ using the static axial load factor $Y_0$. Note also that the contact ellipse may ride over the shoulder even when the axial load on the bearing is below the limit value of $P_0$.

The allowable axial load $F_a$ max of a radial ball bearing is determined as follows. The contact angle $\alpha$ for $F_a$ is determined from the right term of Equation (4.51) and Equation (4.52) while Q is calculated as follows:

$$Q = \frac{F_a}{Z \sin\alpha}$$

$\theta$ of Fig. 4.24 is also determined as follows:

$$2a = A_2 \mu \left(\frac{Q}{\Sigma\rho}\right)^{1/3}$$

$$\therefore \theta \doteqdot \frac{a}{r}$$

Accordingly, the allowable axial load may be determined as the maximum axial load at which the following relation is established.

$$\gamma \geqq \alpha + \theta$$

As the allowable axial load cannot be determined unless internal specifications of a bearing are known, Fig. 4.25 shows the result of a calculation to determine the allowable axial load for a deep groove radial ball bearing.

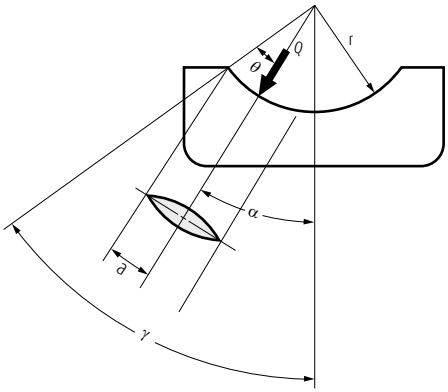



Fig. 4.24

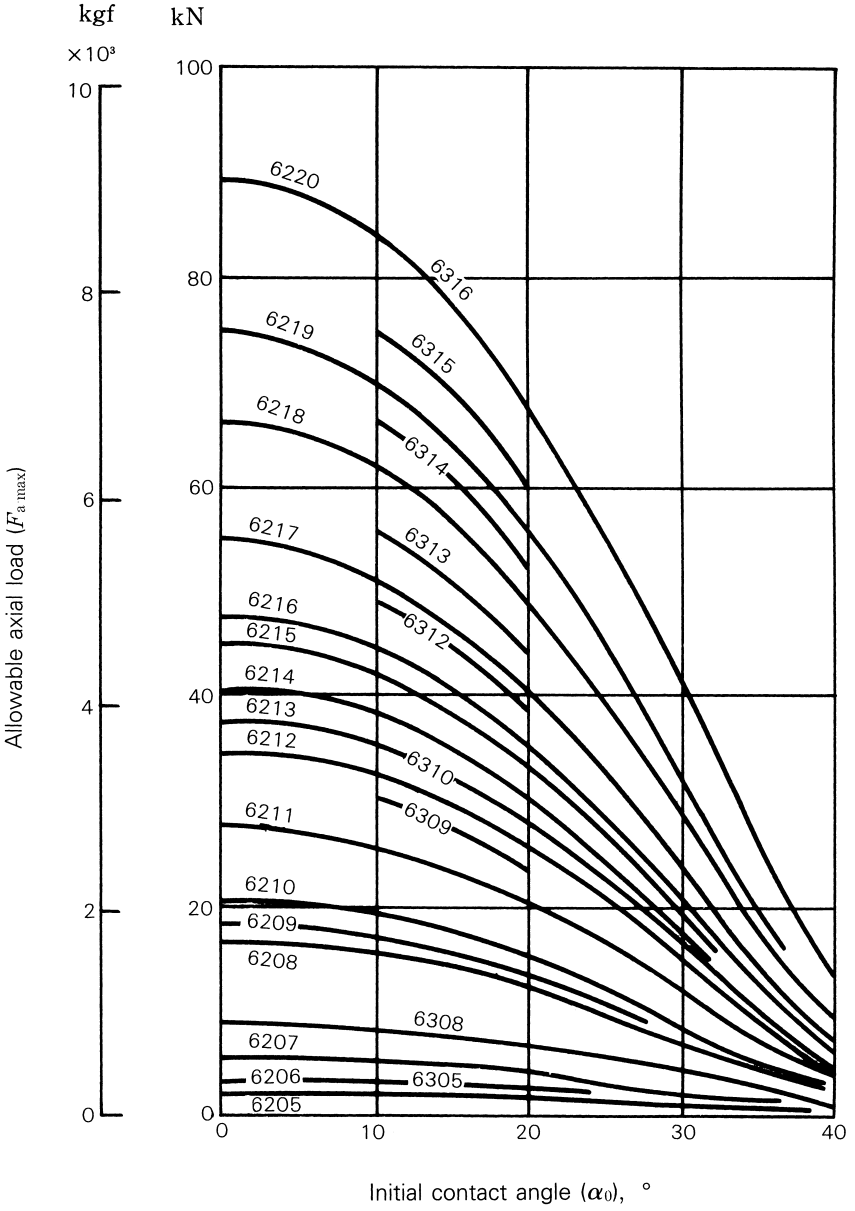



Fig. 4.25 Allowable Axial Load for a Deep Groove Ball Bearing

### 4.7.2 Allowable Axial Load (Break Down Strength of The Ribs) for a Cylindrical Roller Bearings

Both the inner and outer rings may be exposed to an axial load to a certain extent during rotation in a cylindrical roller bearing with ribs. The axial load capacity is limited by heat generation, seizure, etc. at the slip surface between the roller end surface and rib, or the rib strength.
The allowable axial load (the load considered the heat generation between the end face of rollers and the rib face) for the cylindrical roller bearing of the diameter series 3, which is applied continuously under grease or oil lubrication, is shown in Fig. 4.26.

Grease lubrication (Empirical equation)

$$C_A = 9.8 f \left\{ \frac{900\ (k \cdot d)^2}{n + 1\ 500} - 0.023 \times (k \cdot d)^{2.5} \right\} (N)$$

$$= f \left\{ \frac{900\ (k \cdot d)^2}{n + 1\ 500} - 0.023 \times (k \cdot d)^{2.5} \right\} \{kgf\} \quad \cdots\cdots (\mathbf{4.56})$$

Oil lubrication (Empirical equation)

$$C_A = 9.8 f \left\{ \frac{490\ (k \cdot d)^2}{n + 1\ 000} - 0.000135 \times (k \cdot d)^{3.4} \right\} (N)$$

$$= f \left\{ \frac{490\ (k \cdot d)^2}{n + 1\ 000} - 0.000135 \times (k \cdot d)^{3.4} \right\} \{kgf\} \quad \cdots\cdots (\mathbf{4.57})$$

where, $C_A$ : Allowable axial load (N), {kgf}
$d$ : Bearing bore diameter (mm)
$n$ : Bearing speed ($min^{-1}$)
$f$ : Load factor
$k$ : Dimensional factor

In the equations (4.55) and (4.56), the examination for the rib strength is excluded. Concerning the rib strength, please consult with NSK.
To enable the cylindrical roller bearing to sustain the axial load capacity stably, it is necessary to take into account the following points concerning the bearing and its surroundings.

- Radial load must be applied and the magnitude of radial load should be larger than that of axial load by 2.5 times or more.
- There should be sufficient lubricant between the roller end face and rib.
- Use a lubricant with an additive for extreme pressures.
- Running-in-time should be sufficient.
- Bearing mounting accuracy should be good.
- Don't use a bearing with an unnecessarily large internal clearance.

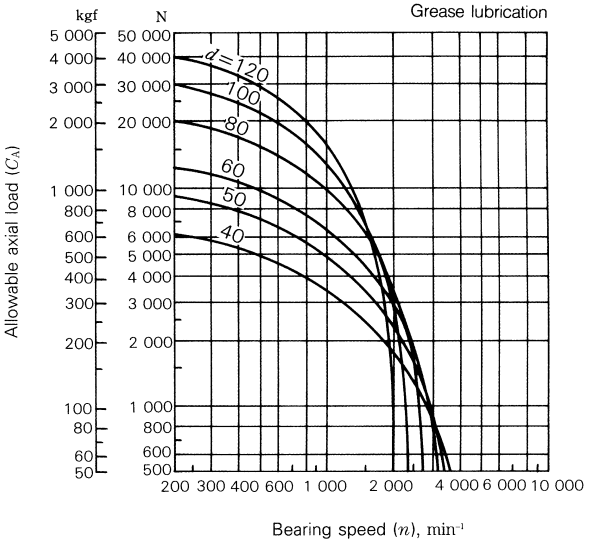
Moreover, if the bearing speed is very slow or exceeds 50% of the allowable speed in the bearing catalog, or if the bearing bore diameter exceeds 200 mm, it is required for each bearing to be precisely checked for lubrication, cooling method, etc. Please contact NSK in such cases.

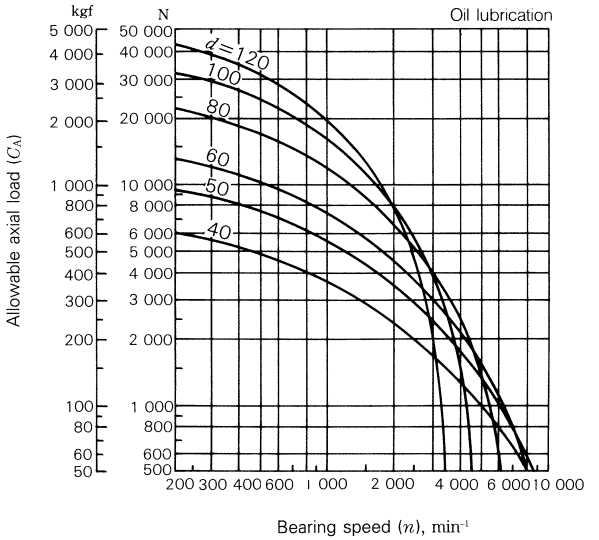
**f : Load factor**

| | f value |
|---|---|
| Continuous loading | 1 |
| Intermittent loading | 2 |
| Short time loading | 3 |

**k : Dimensional factor**

| | k value |
|---|---|
| Bearing diameter series 2 | 0.75 |
| Bearing diameter series 3 | 1 |
| Bearing diameter series 4 | 1.2 |




Conditions are continuous loading ($f = 1$) and bearing diameter series 3 ($k = 1.0$)

Fig. 4.26 Allowable Axial Load for a Cylindrical Roller Bearing

## 4.8 Technical Data

### 4.8.1 Fatigue Life and Reliability

Where any part failure may result in damage to the entire machine and repair of damage is impossible, as in applications such as aircraft, satellites, or rockets, greatly increased reliability is demanded of each component. This concept is being applied generally to durable consumer goods and may also be utilized to achieve effective preventive maintenance of machines and equipment.

The rating fatigue life of a rolling bearing is the gross number of revolutions or the gross rotating period when the rotating speed is constant for which 90% of a group of similar bearings running individually under similar conditions can rotate without suffering material damage due to rolling fatigue. In other words, fatigue life is normally defined at 90% reliability. There are other ways to describe the life. For example, the average value is employed frequently to describe the life span of human beings. However, if the average value were used for bearings, then too many bearings would fail before the average life value is reached. On the other hand, if a low or minimum value is used as a criterion, then too many bearings would have a life much longer than the set value. In this view, the value 90% was chosen for common practice. The value 95% could have been taken as the statistical reliability, but nevertheless, the slightly looser reliability of 90% was taken for bearings empirically from the practical and economical viewpoint. A 90% reliability however is not acceptable for parts of aircraft or electronic computers or communication systems these days, and a 99% or 99.9% reliability is demanded in some of these cases.

The fatigue life distribution when a group of similar bearings are operated individually under similar conditions is shown in Fig. 4.27. The Weibull equation can be used to describe the fatigue life distribution within a damage ratio of 10 to 60% (residual probability of 90 to 40%). Below the damage ratio of 10% (residual probability of 90% or more), however, the rolling fatigue life becomes longer than the theoretical curve of the Weibull distribution, as shown in Fig. 4.28. This is a conclusion drawn from the life test of numerous, widely-varying bearings and an analysis of the data.

When bearing life with a failure ratio of 10% or less (for example, the 95% life or 98% life) is to be considered on the basis of the above concept, the reliability factor a1 as shown in the table below is used to check the life. Assume here that the 98% life $L_2$ is to be calculated for a bearing whose rating fatigue life $L_{10}$ was calculated at 10 000 hours. The life can be calculated as $L_2 = 0.37 \times L_{10} = 3\ 700$ hours. In this manner, the reliability of the bearing life can be matched to the degree of reliability required of the equipment and difficulty of overhaul and inspection.

**Table 4.12 Reliability factor**

| Reliability, % | 90 | 95 | 96 | 97 | 98 | 99 |
|---|---|---|---|---|---|---|
| Life, L | $L_{10}$ rating life | $L_5$ | $L_4$ | $L_3$ | $L_2$ | $L_1$ |
| Reliability factor, $a_1$ | 1 | 0.64 | 0.55 | 0.47 | 0.37 | 0.25 |

Apart from rolling fatigue, factors such as lubrication, wear, sound, and accuracy govern the durability of a bearing. These factors must be taken into account, but the endurance limit of these factors varies depending on application and conditions.

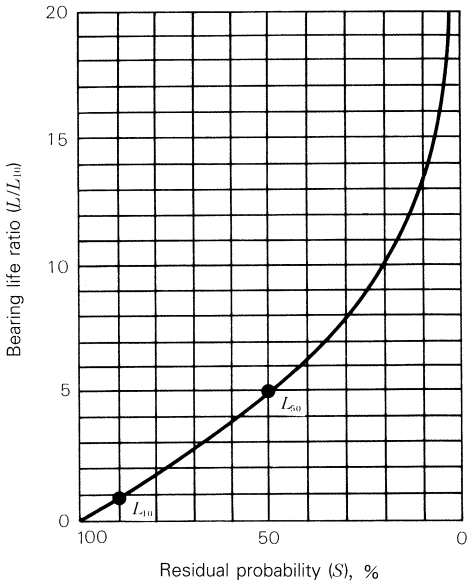



Fig. 4.27 Bearing Life and Residual Probability

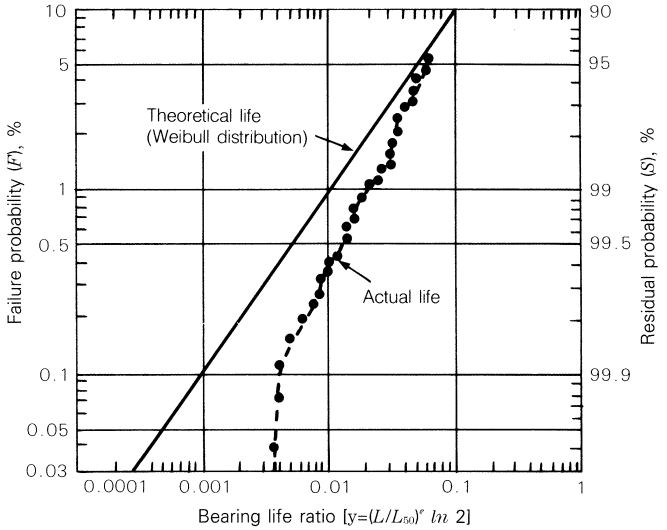



Fig. 4.28 Life Distribution in the Low Failure Ratio Range

### 4.8.2 Radial Clearance and Fatigue Life

As shown in the catalog, etc., the fatigue life calculation equation of rolling bearings is Equation (4.57):

$$L=\left(\frac{C}{P}\right)^{p} \quad \cdots\cdots (\mathbf{4.58})$$

where, L : Rating fatigue life ($10^6$rev)
C : Basic dynamic load rating (N), {kgf}
P : Dynamic equivalent load (N), {kgf}
p : Index Ball bearing p=3,

$$\text{Roller bearing } p=\frac{10}{3}$$

The rating fatigue life L for a radial bearing in this case is based on a prerequisite that the load distribution in the bearing corresponds to the state with the load factor $\varepsilon$ = 0.5 (Fig. 4.29). The load distribution with $\varepsilon$ =0.5 is obtained when the bearing internal clearance is zero. In this sense, the normal fatigue life calculation is intended to obtain the value when the clearance is zero. When the effect of the radial clearance is taken into account, the bearing fatigue life can be calculated as follows. Equations (4.58) and (4.59) can be established between the bearing radial clearance $\Delta_r$ and a function f ($\varepsilon$) of load factor $\varepsilon$:

For deep groove ball bearing

$$\left.\begin{aligned} f(\varepsilon)&=\frac{\Delta_r \cdot D_w^{1/3}}{0.00044\left(\frac{F_r}{Z}\right)^{2/3}} \quad \cdots\cdots (N)\\ f(\varepsilon)&=\frac{\Delta_r \cdot D_w^{1/3}}{0.002\left(\frac{F_r}{Z}\right)^{2/3}} \quad \cdots\cdots \{kgf\}\end{aligned}\right\} \quad \cdots\cdots (\mathbf{4.59})$$

For cylindrical roll bearing

$$\left.\begin{aligned} f(\varepsilon)&=\frac{\Delta_r \cdot L_{we}^{0.8}}{0.000077\left(\frac{F_r}{Z\cdot i}\right)^{0.9}} \quad \cdots\cdots (N)\\ f(\varepsilon)&=\frac{\Delta_r \cdot L_{we}^{0.8}}{0.0006\left(\frac{F_r}{Z\cdot i}\right)^{0.9}} \quad \cdots\cdots \{kgf\}\end{aligned}\right\} \quad \cdots\cdots (\mathbf{4.60})$$

where, $\Delta_r$ : Radial clearance (mm)
$F_r$ : Radial load (N), {kgf}
Z : Number of rolling elements
i : No. of rows of rolling elements
$D_w$ : Ball diameter (mm)
$L_{we}$ : Effective roller length (mm)
$L\varepsilon$ : Life with clearance of $\Delta_r$
L : Life with zero clearance, obtained from Equation (4.57)

The relationship between load factor $\varepsilon$ and f ($\varepsilon$), and the life ratio $L_\varepsilon$ /L, when the radial internal clearance is $\Delta_r$ can also be obtained as shown in Table 4.13.

Fig. 4.30 shows the relationship between the radial clearance and bearing fatigue life while taking 6208 and NU208 as examples.

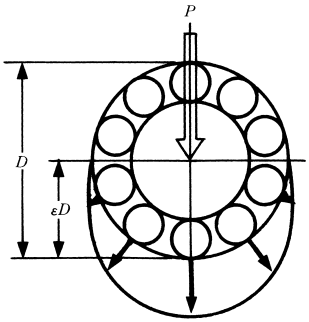



Fig. 4.29 Load Distribution with $\varepsilon$ =0.5

## Table 4.13 ε and f (ε), $L_\varepsilon$ /L

| ε | Deep groove ball bearing | | Cylindrical roller bearing | |
|---|---|---|---|---|
| | f (ε) | $\frac{L_\varepsilon}{L}$ | f (ε) | $\frac{L_\varepsilon}{L}$ |
| **0.1** | 33.713 | 0.294 | 51.315 | 0.220 |
| **0.2** | 10.221 | 0.546 | 14.500 | 0.469 |
| **0.3** | 4.045 | 0.737 | 5.539 | 0.691 |
| **0.4** | 1.408 | 0.889 | 1.887 | 0.870 |
| **0.5** | 0 | 1.0 | 0 | 1.0 |
| **0.6** | − 0.859 | 1.069 | − 1.133 | 1.075 |
| **0.7** | − 1.438 | 1.098 | − 1.897 | 1.096 |
| **0.8** | − 1.862 | 1.094 | − 2.455 | 1.065 |
| **0.9** | − 2.195 | 1.041 | − 2.929 | 0.968 |
| **1.0** | − 2.489 | 0.948 | − 3.453 | 0.805 |
| **1.25** | − 3.207 | 0.605 | − 4.934 | 0.378 |
| **1.5** | − 3.877 | 0.371 | − 6.387 | 0.196 |
| **1.67** | − 4.283 | 0.276 | − 7.335 | 0.133 |
| **1.8** | − 4.596 | 0.221 | − 8.082 | 0.100 |
| **2.0** | − 5.052 | 0.159 | − 9.187 | 0.067 |
| **2.5** | − 6.114 | 0.078 | −11.904 | 0.029 |
| **3** | − 7.092 | 0.043 | −14.570 | 0.015 |
| **4** | − 8.874 | 0.017 | −19.721 | 0.005 |
| **5** | −10.489 | 0.008 | −24.903 | 0.002 |
| **10** | −17.148 | 0.001 | −48.395 | 0.0002 |

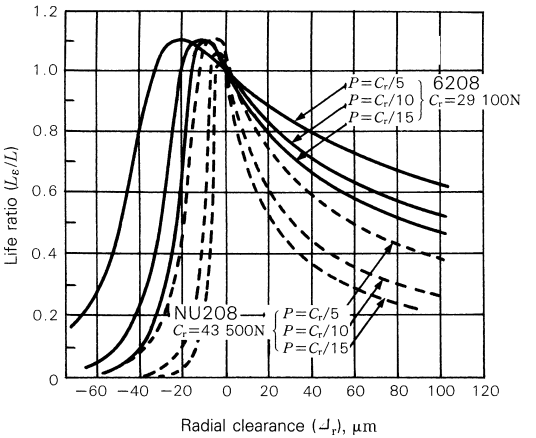



Fig. 4.30 Radial Clearance and Bearing Life Ratio

### 4.8.3 Misalignment of Inner/Outer Rings and Fatigue Life of Deep-Groove Ball Bearings

A rolling bearing is manufactured with high accuracy, and it is essential to take utmost care with machining and assembly accuracies of surrounding shafts and housing if this accuracy is to be maintained. In practice, however, the machining accuracy of parts around the bearing is limited, and bearings are subject to misalignment of inner/outer rings caused by the shaft deflection under external load.

The allowable misalignment is generally 0.0006~0.003 rad (2′ to 10′) but this varies depending on the size of the deep-groove ball bearing, internal clearance during operation, and load. This section introduces the relationship between the misalignment of inner/outer rings and fatigue life. Four different sizes of bearings are selected as examples from the 62 and 63 series deep-groove ball bearings. Assume the fatigue life without misalignment as $L_{\theta=0}$ and the fatigue life with misalignment as $L_\theta$. The effect of the misalignment on the fatigue life may be found by calculating $L_\Theta / L_{\Theta=0}$. The result is shown in Figs. 4.31 to 4.34. As an example of ordinary running conditions, the radial load $F_r$ (N) {kgf} and axial load $F_a$ (N) {kgf} were assumed respectively to be approximately 10% normal load) and 1% (light preload) of the dynamic load rating $C_r$ (N) {kgf} of a bearing and were used as load conditions for the calculation. Normal radial clearance was used and the shaft fit was set to around j5. Also taken into account was the decrease of the internal clearance due to expansion of the inner ring. Moreover, assuming that the temperature difference between the inner and outer rings was 5°C during operation, inner/outer ring misalignment, $L_\theta / L_{\theta=0}$ was calculated for the maximum, minimum, and mean effective clearances. As shown in Figs. 4.31 to 4.34, degradation of the fatigue life is limited to 5 to 10% or less when the misalignment ranges from 0.0006 to 0.003 rad (2′ to 10′), thus not presenting much problem. When the misalignment exceeds a certain limit, however, the fatigue life degrades rapidly as shown in the figure. Attention is therefore necessary in this respect. When the clearance is small, not much effect is observed as long as the misalignment is small, as shown in the figure. But the life decreases substantially when the misalignment increases. As previously mentioned, it is essential to minimize the mounting error as much as possible when a bearing is to be used.

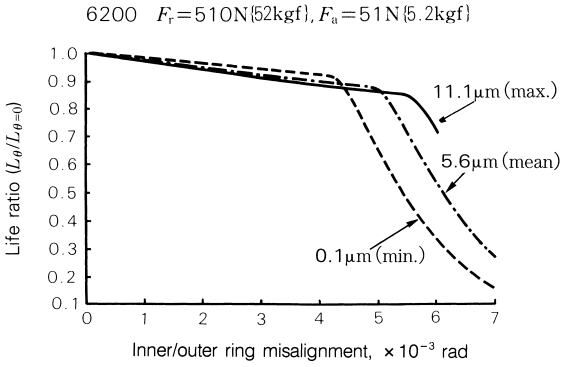



Fig. 4.31

6202 $F_r$=765N{78kgf}, $F_a$=76.5N{7.8kgf}

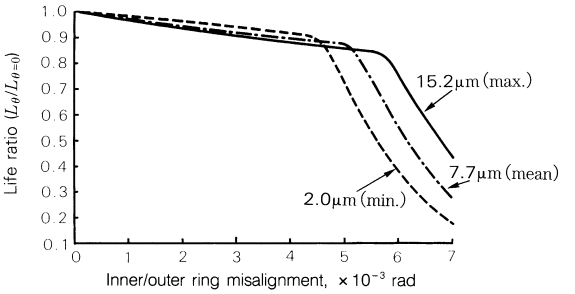



Fig. 4.32

6300 $F_r$=809N{82.5kgf}, $F_a$=80.9N{8.25kgf}

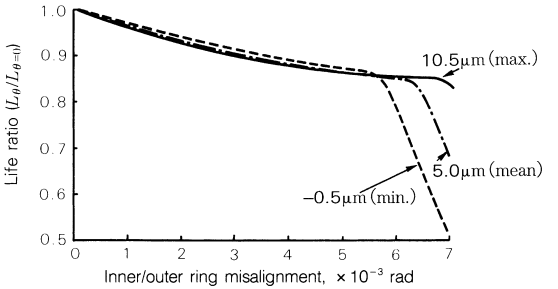



Fig. 4.33

6302 $F_r$=1 147N{117kgf}, $F_a$=114.7N{11.7kgf}

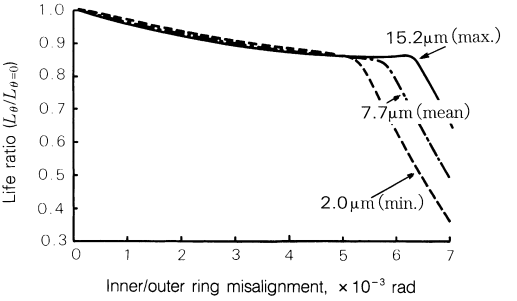



Fig. 4.34

### 4.8.4 Misalignment of Inner/Outer Rings and Fatigue Life of Cylindrical Roller Bearings

When a shaft supported by rolling bearings is deflected or there is some inaccuracy in a shoulder, there arises misalignment between the inner and outer rings of the bearings, thereby lowering their fatigue life. The degree of life degradation depends on the bearing type and interior design but also varies depending on the radial internal clearance and the magnitude of load during operation.
The relationship between the misalignment of inner/outer rings and fatigue life was determined, as shown in Figs. 4.35 to 4.38, while using cylindrical roller bearings NU215 and NU315 of standard design. In these figures, the horizontal axis shows the misalignment of inner/outer rings (rad) while the vertical axis shows the fatigue life ratio $L_\theta / L_{\theta=0}$. The fatigue life without misalignment is $L_\Theta = 0$ and that with misalignment is $L_\theta$.

Figs. 4.35 and 4.36 show the case with constant load (10% of basic dynamic load rating $C_r$ of a bearing) for each case when the internal clearance is a normal, C3 clearance, or C4 clearance. Figs. 4.37 and 4.38 show the case with constant clearance (normal clearance) when the load is 5%, 10%, and 20% of the basic dynamic load rating $C_r$. Note that the median effective clearance in these examples was determined using m5/H7 fits and a temperature difference of 5°C between the inner and outer rings. The fatigue life ratio for the clearance and load shows the same trend as in the case of other cylindrical roller bearings. But the life ratio itself differs among bearing series and dimensions, with life degradation rapid in 22 and 23 series bearings (wide type). It is advisable to use a bearing of special design when considerable misalignment is expected during application.

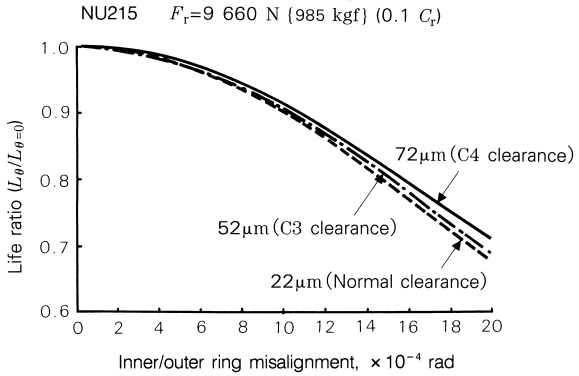



Fig. 4.35

NU315 $F_r$=17 950 N {1 830 kgf} (0.1 $C_r$)

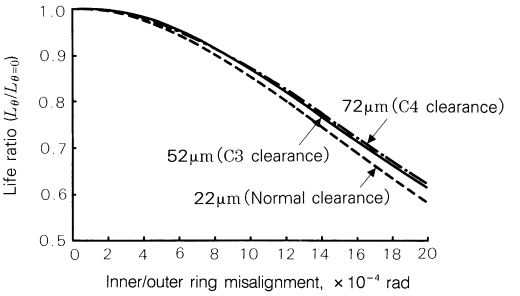



Fig. 4.36

NU215 22μm (Normal clearance)

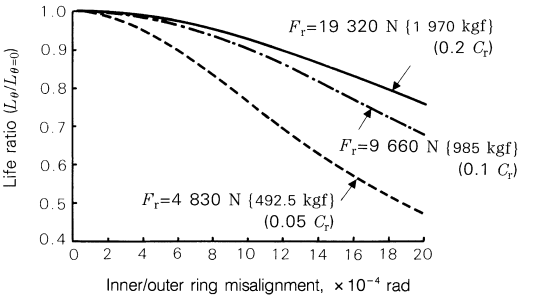



Fig. 4.37

NU315 22μm (Normal clearance)

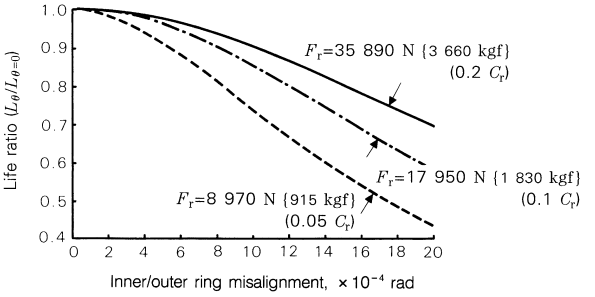



Fig. 4.38

### 4.8.5 Oil Film Parameters and Rolling Fatigue Life

Based on numerous experiments and experiences, the rolling fatigue life of rolling bearings can be shown to be closely related to the lubrication. The rolling fatigue life is expressed by the maximum number of rotations, which a bearing can endure, until the raceway or rolling surface of a bearing develops fatigue in the material, resulting in flaking of the surface, under action of cyclic stress by the bearing.

Such flaking begins with either microscopic nonuniform portions (such as non-metallic inclusions, cavities) in the material or with microscopic defect in the material's surface (such as extremely small cracks or surface damage or dents caused by contact between extremely small projections in the raceway or rolling surface). The former flaking is called sub-surface originating flaking while the latter is surface-originating flaking.

The oil film parameter ($\Lambda$), which is the ratio between the resultant oil film thickness and surface roughness, expresses whether or not the lubrication state of the rolling contact surface is satisfactory. The effect of the oil film grows with increasing $\Lambda$. Namely, when $\Lambda$ is large (around 3 in general), surface-originating flaking due to contact between extremely small projections in the surface is less likely to occur. If the surface is free from defects (flaw, dent, etc.), the life is determined mainly by sub-surface originating flaking. On the other hand, a decrease in $\Lambda$ tends to develop surface-originating flaking, resulting in degradation of the bearing's life. This state is shown in Fig. 4.39.

NSK has performed life experiments with about 370 bearings within the range of $\Lambda$ =0.3 ~ 3 using different lubricants and bearing materials (● and ▲ in Fig. 4.40). Fig. 4.40 shows a summary of the principal experiments selected from among those reported up to now. As is evident, the life decreases rapidly at around $\Lambda \fallingdotseq 1$ when compared with the life values at around $\Lambda$=3 ~ 4 where life changes at a slower rate. The life becomes about 1/10 or less at $\Lambda \leqq 0.5$. This is a result of severe surface-originating flaking. Accordingly, it is advisable for extension of the fatigue life of rolling bearings to increase the oil film parameter (ideally to a value above 3) by improving lubrication conditions.

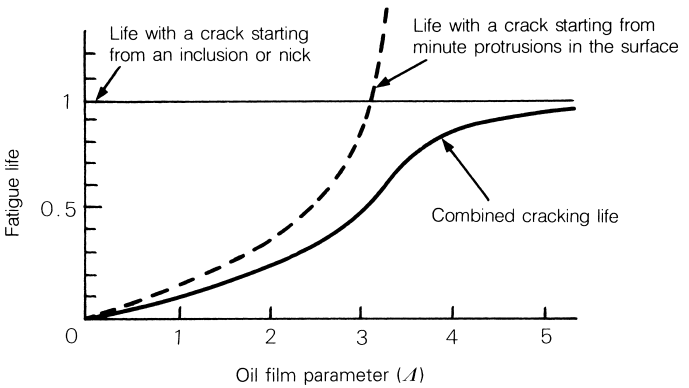



Fig. 4.39 Expression of Life According to $\Lambda$ (Tallian, et al.)

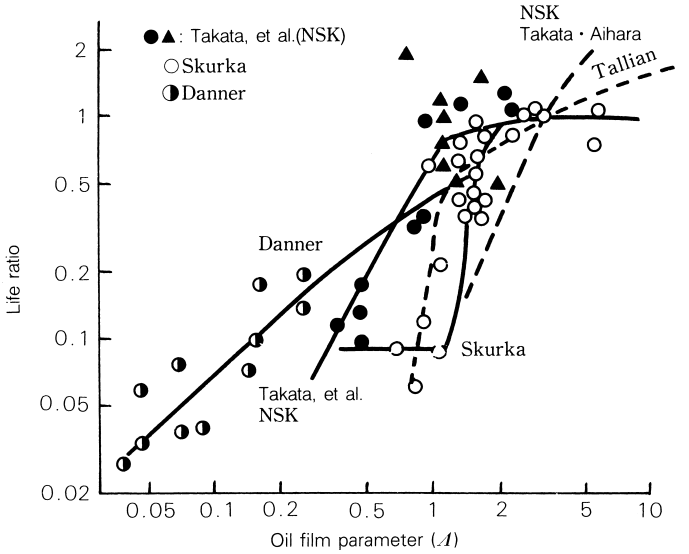



Fig. 4.40 Typical Experiment with $\Lambda$ and Rolling Fatigue Life (Expressed with reference to the life at $\Lambda$=3)

### 4.8.6 EHL Oil Film Parameter Calculation Diagram

Lubrication of rolling bearings can be expressed by the theory of elastohydrodynamic lubrication (EHL). Introduced below is a method to determine the oil film parameter (oil film – surface roughness ratio), the most critical among the EHL qualities.

#### (1) Oil Film Parameter

The raceway surfaces and rolling surfaces of a bearing are extremely smooth, but have fine irregularities when viewed through a microscope. As the EHL oil film thickness is in the same order as the surface roughness, lubricating conditions cannot be discussed without considering this surface roughness. For example, given a particular mean oil film thickness, there are two conditions which may occur depending on the surface roughness. One consists of complete separation of the two surfaces by means of the oil film (Fig. 4.41 (a)). The other consists of metal contact between surface projections (Fig. 4.41 (b)). The degradation of lubrication and surface damage is attributed to case (b). The symbol lambda ($\Lambda$) represents the ratio between the oil film thickness and roughness. It is widely employed as an oil film parameter in the study and application of EHL.

$$\Lambda = h/\sigma \quad \cdots\cdots (\mathbf{4.61})$$

where h : EHL oil film thickness

$\sigma$ : Combined roughness ($\sqrt{\sigma_1^2+\sigma_2^2}$)

$\sigma_1$, $\sigma_2$ : Root mean square (rms) roughness of each contacting surface

The oil film parameter may be correlated to the formation of the oil film as shown in Figs. 4.42 and the degree of lubrication can be divided into three zones as shown in the figure.

#### (2) Oil Film Parameter Calculation Diagram

The **Dowson-Higginson** minimum oil film thickness equation shown below is used for the diagram:

$$H_{min} = 2.65 \frac{G^{0.54}U^{0.7}}{W^{0.13}} \quad \cdots\cdots (\mathbf{4.62})$$

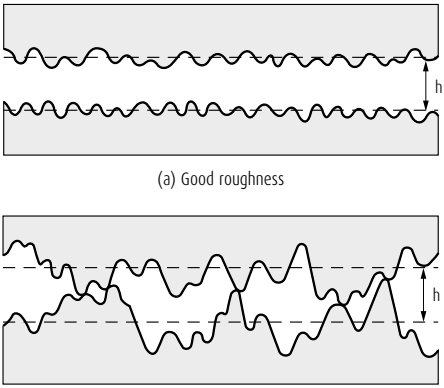
The oil film thickness to be used is that of the inner ring under the maximum rolling element load (at which the thickness becomes minimum).
Equation (4.61) can be expressed as follows by grouping into terms (R) for speed, (A) for viscosity,
(F) for load, and (J) for bearing technical specifications.
$t$ is a constant.

$$\Lambda = t \cdot R \cdot F \cdot J \quad \cdots\cdots (\mathbf{4.63})$$

R and A may be quantities not dependent on a bearing. When the load P is assumed to be between 98 N {10 kgf} and 98 kN {10 tf}, F changes by 2.54 times as $F \propto P^{-0.13}$. Since the actual load is determined roughly from the bearing size, however, such change may be limited to 20 to 30%. As a result, F is handled as a lump with the term J of bearing specifications [F=F (J)]. Traditional Equation (4.62) can therefore be grouped as shown below:

$$\Lambda = T \cdot R \cdot A \cdot D \quad \cdots\cdots (\mathbf{4.64})$$

where, T : Factor determined by the bearing Type
R : Factor related to Rotation speed
A : Factor related to viscosity (viscosity grade $\alpha$: Alpha)
D : Factor related to bearing Dimensions




(a) Good roughness

(b) High roughness

Fig. 4.41 Oil Film and Surface Roughness

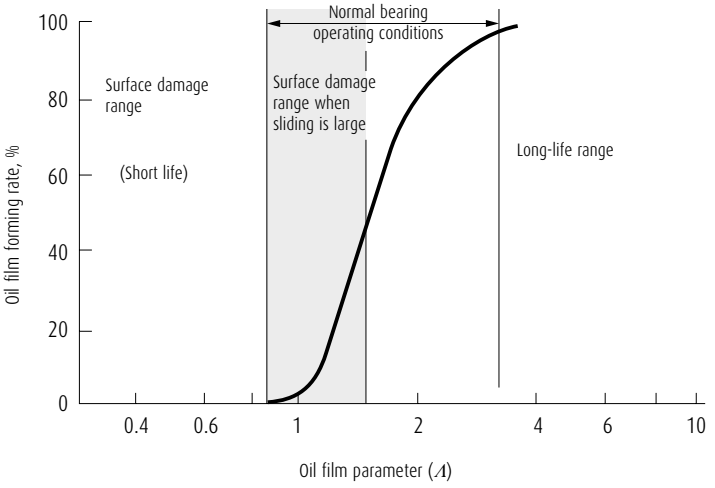



Fig. 4.42 Effect of Oil Film on Bearing Performance

The oil film parameter $\Lambda$, which is most vital among quantities related to EHL, is expressed by a simplified equation shown below. The fatigue life of rolling bearings becomes shorter when $\Lambda$ is smaller. In the equation $\Lambda = T \cdot R \cdot A \cdot D$ terms include A for oil viscosity $\eta_0$ (mPa· s, {cp}), R for the speed n ($min^{-1}$), and D for bearing bore diameter d (mm). The calculation procedure is described below.

(i) Determine the value T from the bearing type (Table 4.14).
(ii) Determine the R value for n ($min^{-1}$) from Fig. 4.43.
(iii)Determine A from the absolute viscosity (mPa· s, {cp}) and oil kind in Fig. 4.44.

Generally, the kinematic viscosity $\nu_0$ ($mm^2/s$, {cSt}) is used and conversion is made as follows:

$$\eta_0 = \rho \cdot \nu_0 \quad \cdots\cdots (\mathbf{4.65})$$

$\rho$ is the density ($g/cm^3$) and uses the approximate value as shown below:

Mineral oil $\rho = 0.85$
Silicon oil $\rho = 1.0$
Diester oil $\rho = 0.9$

When it is not known whether the mineral oil is naphthene or paraffin, use the paraffin curve shown in Fig. 4.44.

(iv) Determine the D value from the diameter series and bore diameter d (mm) in Fig. 4.45.
(v) The product of the above values is used as an oil film parameter.

**Table 4.14 Value T**

| Bearing type | Value T |
|---|---|
| Ball bearing | 1.5 |
| Cylindrical roller bearing | 1.0 |
| Tapered roller bearing | 1.1 |
| Spherical roller bearing | 0.8 |

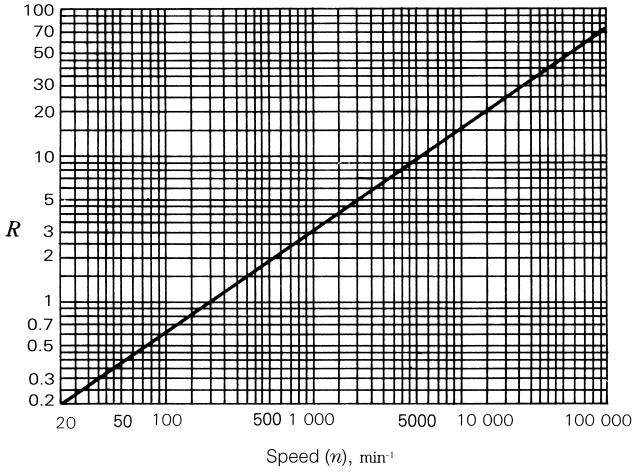



Fig. 4.43 Speed Term, R

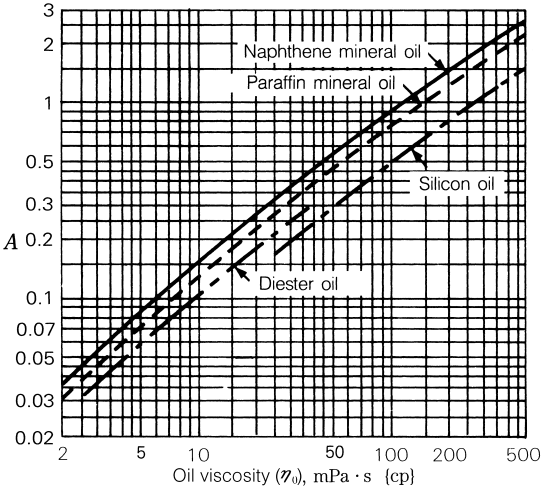



Fig. 4.44 Term Related to Lubricant Viscosity, A

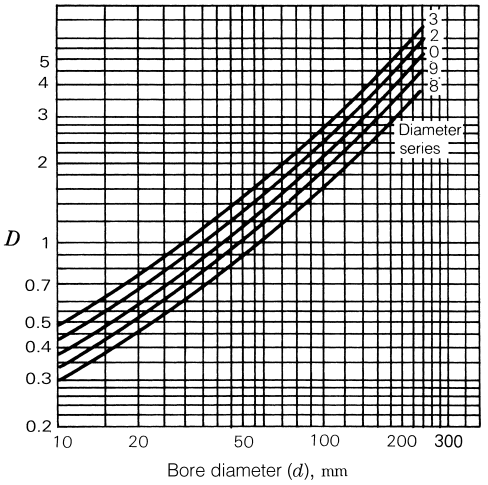



Fig. 4.45 Term Related to Bearing Specifications, D

Examples of EHL oil film parameter calculation are described below.

**(Example 1)**

The oil film parameter is determined when a deep groove ball bearing 6312 is operated with paraffin mineral oil ($\eta_0$ = 30 mPa· s, {cp}) at the speed n =1 000 $min^{-1}$.

**(Solution)**

d = 60 mm and D = 130 mm from the bearing catalog.
T = 1.5 from Table 4.18
R = 3.0 from Fig. 4.43
A = 0.31 from Fig. 4.44
D = 1.76 from Fig. 4.45
Accordingly, $\Lambda$ = 2.5

**(Example 2)**

The oil film parameter is determined when a cylindrical roller bearing NU240 is operated with paraffin mineral oil ($\eta_0$ = 10 mPa· s, {cp}) at the speed n = 2 500 $min^{-1}$.

**(Solution)**

d = 200 mm and D = 360 mm from the bearing catalog.
T = 1.0 from Table 4.18
R = 5.7 from Fig. 4.43
A = 0.13 from Fig. 4.44
D = 4.8 from Fig. 4.45
Accordingly, $\Lambda$ = 3.6

### (3) Effect of Oil Shortage and Shearing Heat Generation

The oil film parameter obtained above is the value when the requirements, that is, the contact inlet fully flooded with oil and isothermal inlet are satisfied. However, these conditions may not be satisfied depending on lubrication and operating conditions. One such condition is called starvation, and the actual oil film paramerer value may become smaller than determined by Equation (4.64). Starvation might occur if lubrication becomes limited. In this condition, a guideline for adjusting the oil film parameter is 50 to 70% of the value obtained from Equation (4.64).

Another effect is the localized temperature rise of oil in the contact inlet due to heavy shearing during highspeed operation, resulting in a decrease of the oil viscosity. In this case, the oil film parameter becomes smaller than the isothermal theoretical value. The effect of shearing heat generation was analyzed by Murch and Wilson, who established the decrease factor of the oil film parameter. An approximation using the viscosity and speed (pitch diameter of rolling element set $D_{pw}$ × rotating speed per minute n as parameters) is shown in Fig. 4.46. By multiplying the oil film parameter determined in the previous section by this decrease factor Hi the oil film parameter considering the shearing heat generation is obtained.
Namely;

$$\Lambda = Hi \cdot T \cdot R \cdot A \cdot D \quad \cdots\cdots (\mathbf{4.66})$$

Note that the average of the bore and outside diameters of the bearings may be used as the pitch diameter $D_{pw}$ ($d_m$) of rolling element set.
Conditions for the calculation (Example 1) include $d_m n = 9.5 \times 10^4$ and $\eta_0$ = 30 mPa · s, {cp}, and Hi is nearly equivalent to 1 as is evident from Fig. 4.46. There is therefore almost no effect of shearing heat generation. Conditions for (Example 2) are $d_m n = 7 \times 10^5$ and $\eta_0$ = 10 mPa · s, {cp} while Hi = 0.76, which means that the oil film parameter is smaller by about 25%. Accordingly, $\Lambda$ is actually 2.7, not 3.6.

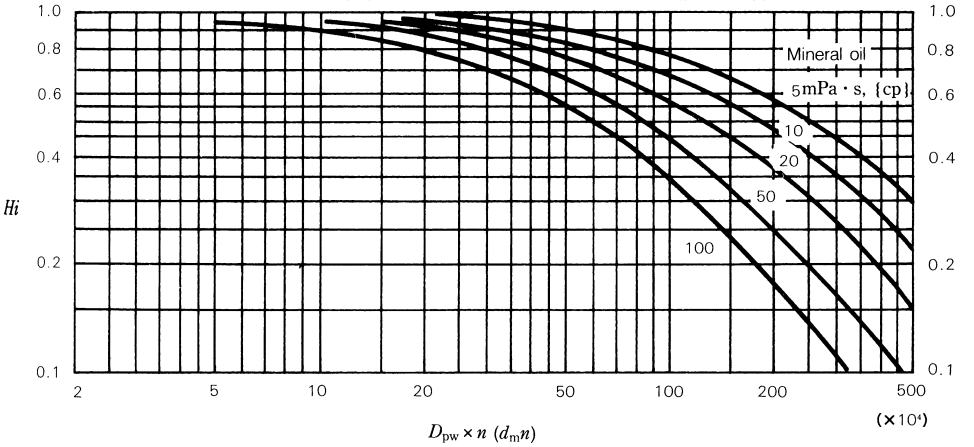



Fig. 4.46 Oil film thickness decrease factor HI due to shearing heat generation

### 4.8.7 Load Calculation of Gears

#### (1) Calculation of Loads on Spur, Helical, and Double-Helical Gears

There is an extremely close relationship among the two mechanical elements, gears and rolling bearings. Gear units, which are widely used in machines, are almost always used with bearings. Rating life calculation and selection of bearings to be used in gear units are based on the load at the gear meshing point. The load at the gear meshing point is calculated as follows:

**Spur Gear:**

$$P_1 = P_2 = \frac{9\,550\,000H}{n_1\left(\frac{d_{p1}}{2}\right)} = \frac{9\,550\,000H}{n_2\left(\frac{d_{p2}}{2}\right)} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \text{(N)}$$

$$= \frac{974\,000H}{n_1\left(\frac{d_{p1}}{2}\right)} = \frac{974\,000H}{n_2\left(\frac{d_{p2}}{2}\right)} \quad \cdots\cdots \{\text{kgf}\}$$

$$S_1 = S_2 = P_1 \tan\alpha$$

The magnitudes of the forces $P_2$ and $S_2$ applied to the driven gear are the same as $P_1$ and $S_1$ respectively, but the direction is opposite.

**Helical Gear:**

$$P_1 = P_2 = \frac{9\,550\,000H}{n_1\left(\frac{d_{p1}}{2}\right)} = \frac{9\,550\,000H}{n_2\left(\frac{d_{p2}}{2}\right)} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \text{(N)}$$

$$= \frac{974\,000H}{n_1\left(\frac{d_{p1}}{2}\right)} = \frac{974\,000H}{n_2\left(\frac{d_{p2}}{2}\right)} \quad \cdots\cdots \{\text{kgf}\}$$

$$S_1 = S_2 = \frac{P_1 \tan\alpha_n}{\cos\beta}$$

$$T_1 = T_2 = P_1 \tan\beta$$

The magnitudes of the forces $P_2$, $S_2$, and $T_2$ applied to the driven gear are the same as $P_1$, $S_1$, and $T_1$ respectively, but the direction is opposite.

**Double-Helical Gear:**

$$P_1 = P_2 = \frac{9\,550\,000H}{n_1\left(\frac{d_{p1}}{2}\right)} = \frac{9\,550\,000H}{n_2\left(\frac{d_{p2}}{2}\right)} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \text{(N)}$$

$$= \frac{974\,000H}{n_1\left(\frac{d_{p1}}{2}\right)} = \frac{974\,000H}{n_2\left(\frac{d_{p2}}{2}\right)} \quad \cdots\cdots \{\text{kgf}\}$$

$$S_1 = S_2 = \frac{P_1 \tan\alpha_n}{\cos\beta}$$

where, $P$ : Tangential force (N), {kgf}
$S$ : Separating force (N), {kgf}
$T$ : Thrust (N), {kgf}
$H$ : Transmitted power (kW)
$n$ : Speed ($min^{-1}$)
$d_p$ : Pitch diameter (mm)
$a$ : Gear pressure angle
$a_n$ : Gear normal pressure angle
$\beta$ : Twist angle
Subscript 1: Driving gear
Subscript 2: Driven gear

In the case of double-helical gears, thrust of the helical gears offsets each other and thus only tangential and separating forces act. For the directions of tangential, separating, and thrust forces, please refer to Figs. 4.47 and 4.48.

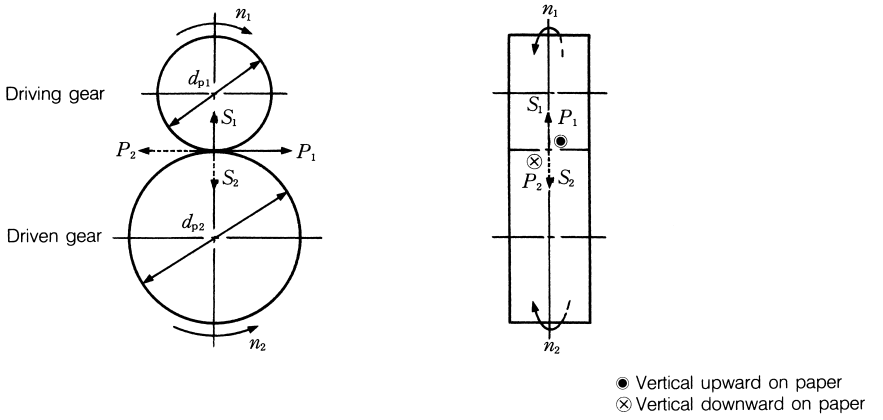



Fig. 4.47 Spur Gear

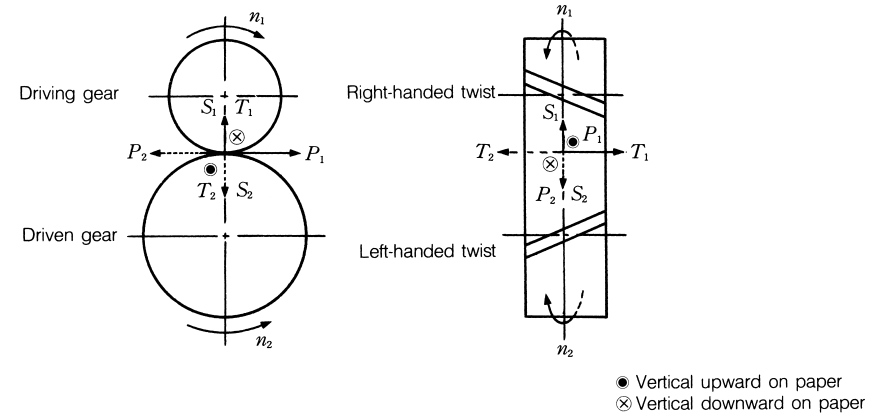



Fig. 4.48 Helical Gear

The thrust direction of the helical gear varies depending on the gear running direction, gear twist direction, and whether the gear is driving or driven. The directions are as follows:
The force on the bearing is determined as follows:
Tangential force:

$$P_1 = P_2 = \frac{9\ 550\ 000H}{n_1\left(\frac{d_{p1}}{2}\right)} = \frac{9\ 550\ 000H}{n_2\left(\frac{d_{p2}}{2}\right)} \quad \cdots\cdots (N)$$

$$= \frac{974\ 000H}{n_1\left(\frac{d_{p1}}{2}\right)} = \frac{974\ 000H}{n_2\left(\frac{d_{p2}}{2}\right)} \quad \cdots\cdots \{kgf\}$$

Separating force: $S_1 = S_2 = P_1 \frac{\tan\alpha_n}{\cos\beta}$

Thrust: $T_1 = T_2 = P_1 \cdot \tan\beta$
The same method can be applied to bearings C and D.

**Table 4.15**

| Load classification | | Bearing A | Bearing B |
|---|---|---|---|
| Radial load | From $P_1$ | $P_A = \frac{b}{a+b} P_1$ ⊗ | $P_B = \frac{a}{a+b} P_1$ ⊗ |
| | From $S_1$ | $S_A = \frac{b}{a+b} S_1$ ↑ | $S_B = \frac{a}{a+b} S_1$ ↑ |
| | From $T_1$ | $U_A = \frac{d_{p1}/2}{a+b} T_1$ ↑ | $U_B = \frac{d_{p1}/2}{a+b} T_1$ ↓ |
| Combined radial load | | $F_{rA} = \sqrt{P_A^2 + (S_A + U_A)^2}$ | $F_{rB} = \sqrt{P_B^2 + (S_B + U_B)^2}$ |
| Axial load | | $F_a = T_1$ ← | |

Load direction is shown referring to left side of Fig. 4.49.

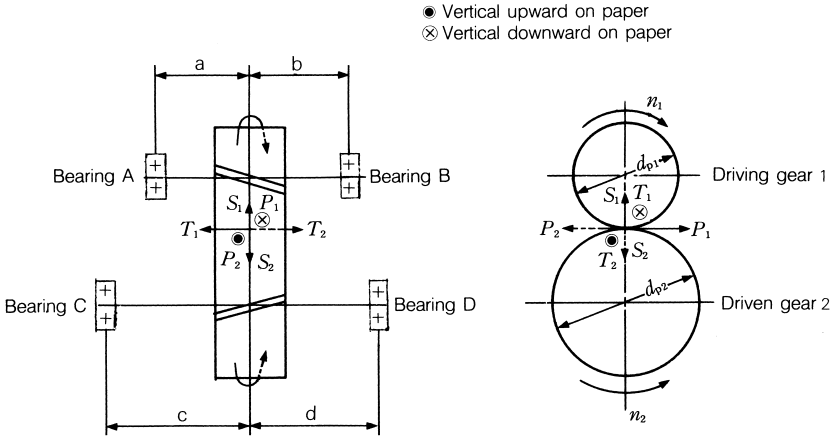



Fig. 4.49

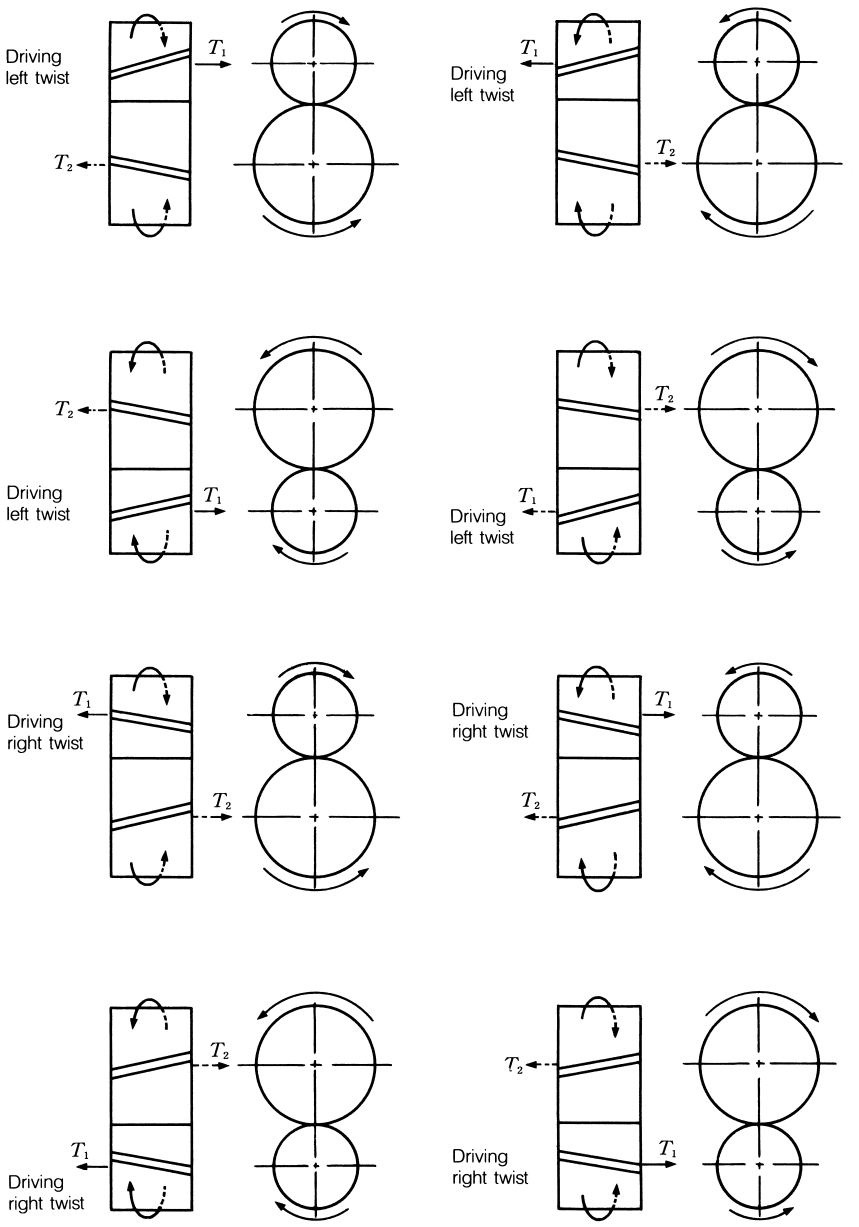



Fig. 4.50 Thrust Direction

## (2) Calculation of Load Acting on Straight Bevel Gears

The load at the meshing point of straight bevel gears is calculated as follows:

$$P_1 = P_2 = \frac{9\ 550\ 000H}{n_1\left(\frac{D_{m1}}{2}\right)} = \frac{9\ 550\ 000H}{n_1\left(\frac{D_{m2}}{2}\right)} \quad \cdots\cdots (N)$$

$$= \frac{974\ 000H}{n_1\left(\frac{D_{m1}}{2}\right)} = \frac{974\ 000H}{n_2\left(\frac{D_{m2}}{2}\right)} \quad \cdots\cdots \{kgf\}$$

$D_{m1} = d_{p1} - w \sin\delta_1$
$D_{m2} = d_{p2} - w \sin\delta_2$

$S_1 = P_1 \tan\alpha_n \cos\delta_1$
$S_2 = P_2 \tan\alpha_n \cos\delta_2$

$T_1 = P_1 \tan\alpha_n \cos\delta_1$
$T_2 = P_2 \tan\alpha_n \cos\delta_2$

where, $D_m$ : Average pitch diameter (mm)
$d_p$ : Pitch diameter (mm)
$w$ : Gear width (pitch line length) (mm)
$\alpha_n$ : Gear normal pressure angle
$\delta$ : Pitch cone angle

Generally, $\delta_1 + \delta_2 = 90°$. In this case, $S_1$ and $T_2$ (or $S_2$ and $T_1$) are the same in magnitude but opposite in direction. S/P and T/P for $\delta$ are shown in Fig. 4.53. The load on the bearing can be calculated as shown below.

**Table 4.16**

◉ Vertical upward on paper
⊗ Vertical downward on paper

| Load classification | | Bearing A | Bearing B | Bearing C | Bearing D |
|---|---|---|---|---|---|
| Radial load | From $P_1$ | $P_A = \frac{b}{a} P_1$ ◉ | $P_B = \frac{a+b}{a} P_1$ ⊗ | $P_C = \frac{d}{c+d} P_2$ ◉ | $P_D = \frac{c}{c+d} P_2$ ◉ |
| | From $S_1$ | $S_A = \frac{b}{a} S_1$ ↓ | $S_B = \frac{a+b}{a} S_1$ ↑ | $S_C = \frac{d}{c+d} S_2$ → | $S_D = \frac{c}{c+d} S_2$ → |
| | From $T_1$ | $U_A = \frac{D_{m1}}{2 \cdot a} T_1$ ↑ | $U_B = \frac{D_{m1}}{2 \cdot a} T_1$ ↓ | $U_C = \frac{D_{m2}}{2(c+d)} T_2$ ← | $U_D = \frac{D_{m2}}{2(c+d)} T_2$ ← |
| Combined radial load | | $F_{rA} = \sqrt{P_A^2 + (S_A + U_A)^2}$ | $F_{rB} = \sqrt{P_B^2 + (S_B + U_B)^2}$ | $F_{rC} = \sqrt{P_C^2 + (S_C + U_C)^2}$ | $F_{rD} = \sqrt{P_D^2 + (S_D + U_D)^2}$ |
| Axial load | | $F_a = T_1$ | | $F_a = T_2$ | |

Load direction is shown referring to Fig. 4.52.

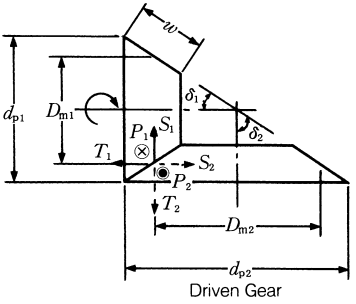



Fig. 4.51

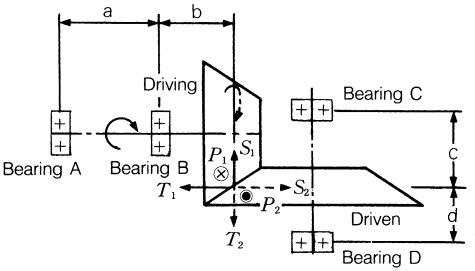



Fig. 4.52

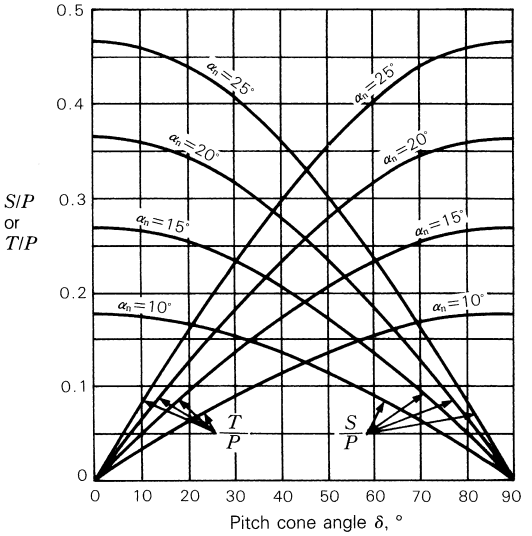



Fig. 4.53

### (3) Calculation of Load on Spiral Bevel Gears

In the case of spiral bevel gears, the magnitude and direction of loads at the meshing point vary depending on the running direction and gear twist direction. The running is either clockwise or counterclockwise as viewed from the side opposite of the gears (Fig. 4.54). The gear twist direction is classified as shown in Fig. 4.55. The force at the meshing point is calculated as follows:

$$P_1 = P_2 = \frac{9\ 550\ 000H}{n_1\left(\frac{D_{m1}}{2}\right)} = \frac{9\ 550\ 000H}{n_2\left(\frac{D_{m2}}{2}\right)} \quad \cdots\cdots\cdots\

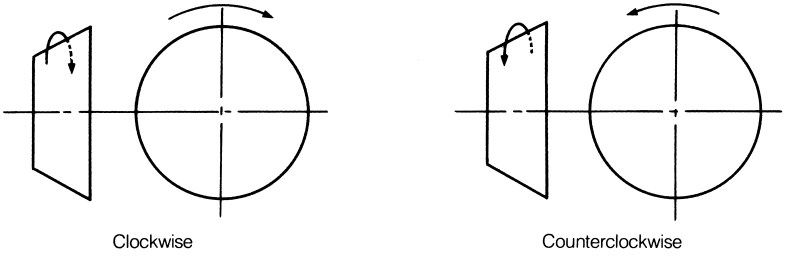



Fig. 4.54



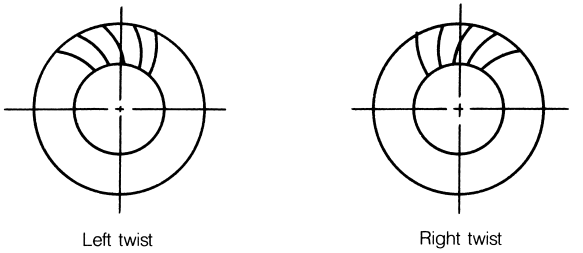



Fig. 4.55

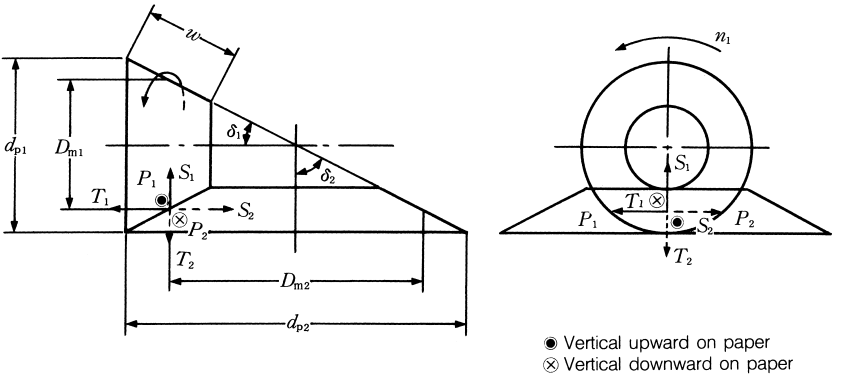



Fig. 4.56

### (4) Calculation of Load Acting on Hypoid Gears

The force acting at the meshing point of hypoid gears is calculated as follows:

$$P_1 = \frac{9\ 550\ 000H}{n_1\left(\frac{D_{m1}}{2}\right)} = \frac{\cos\beta_1}{\cos\beta_2} P_2 \quad \text{(N)}$$

$$= \frac{974\ 000H}{n_1\left(\frac{D_{m1}}{2}\right)} = \frac{\cos\beta_1}{\cos\beta_2} P_2 \quad \text{\{kgf\}}$$

$$P_2 = \frac{9\ 550\ 000H}{n_2\left(\frac{D_{m2}}{2}\right)} \quad \text{(N)}$$

$$= \frac{974\ 000H}{n_2\left(\frac{D_{m2}}{2}\right)} \quad \text{\{kgf\}}$$

$$D_{m1} = D_{m2}\frac{z_1}{z_2} \cdot \frac{\cos\beta_1}{\cos\beta_2}$$

$$D_{m2} = d_{p2} - w_2\sin\delta_2$$

where, $\alpha_n$ : Gear normal pressure angle
$\beta$ : Twisting angle
$\delta$ : Pitch cone angle
w : Gear width (mm)
$D_m$ : Average pitch diameter (mm)
$d_p$ : Pitch diameter (mm)
z : Number of teeth

Note that the following applies:

$D_{m1} = d_{p1} - w\sin\delta_1$
$D_{m2} = d_{p2} - w\sin\delta_2$

The separating force S and T are as follows depending on the running direction and gear twist direction:

(i) Clockwise with right twisting or counterclockwise with left twisting

Driving Gear
Separating Force

$$S_1 = \frac{P_1}{\cos\beta}(\tan\alpha_n \cos\delta_1 + \sin\beta \sin\delta_1)$$

Thrust

$$T_1 = \frac{P_1}{\cos\beta}(\tan\alpha_n \sin\delta_1 - \sin\beta \cos\delta_1)$$

Driven Gear
Separating Force

$$S_2 = \frac{P_2}{\cos\beta}(\tan\alpha_n \cos\delta_2 + \sin\beta \sin\delta_2)$$

Thrust

$$T_2 = \frac{P_2}{\cos\beta}(\tan\alpha_n \sin\delta_2 - \sin\beta \cos\delta_2)$$

(ii) Clockwise with right twisting or counterclockwise with left twisting

Driving Gear
Separating Force

$$S_1 = \frac{P_1}{\cos\beta}(\tan\alpha_n \cos\delta_1 + \sin\beta \sin\delta_1)$$

Thrust

$$T_1 = \frac{P_1}{\cos\beta}(\tan\alpha_n \sin\delta_1 - \sin\beta \cos\delta_1)$$

Driven Gear
Separating Force

$$S_2 = \frac{P_2}{\cos\beta}(\tan\alpha_n \cos\delta_2 + \sin\beta \sin\delta_2)$$

Thrust

$$T_2 = \frac{P_2}{\cos\beta}(\tan\alpha_n \sin\delta_2 - \sin\beta \cos\delta_2)$$

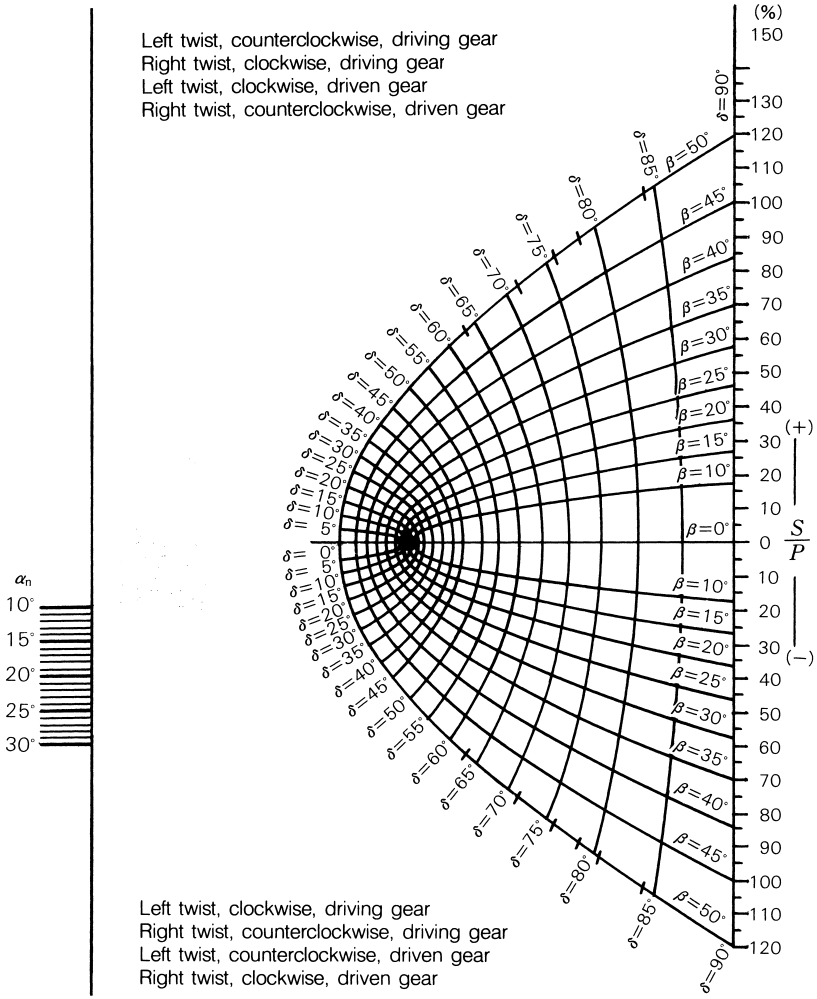
The positive (plus) calculation result means that the load is acting in a direction to separate the gears while a negative (minus) one means that the load is acting in a direction to bring the gears nearer. For the running direction and gear twist direction, refer to Section 4.8.7 (3), "Calculation of Load on Spiral Bevel Gears."

The load on the bearing can be calculated by the same method as described in Section 4.8.7 (2), "Calculation of Load Acting on Straight Bevel Gears."

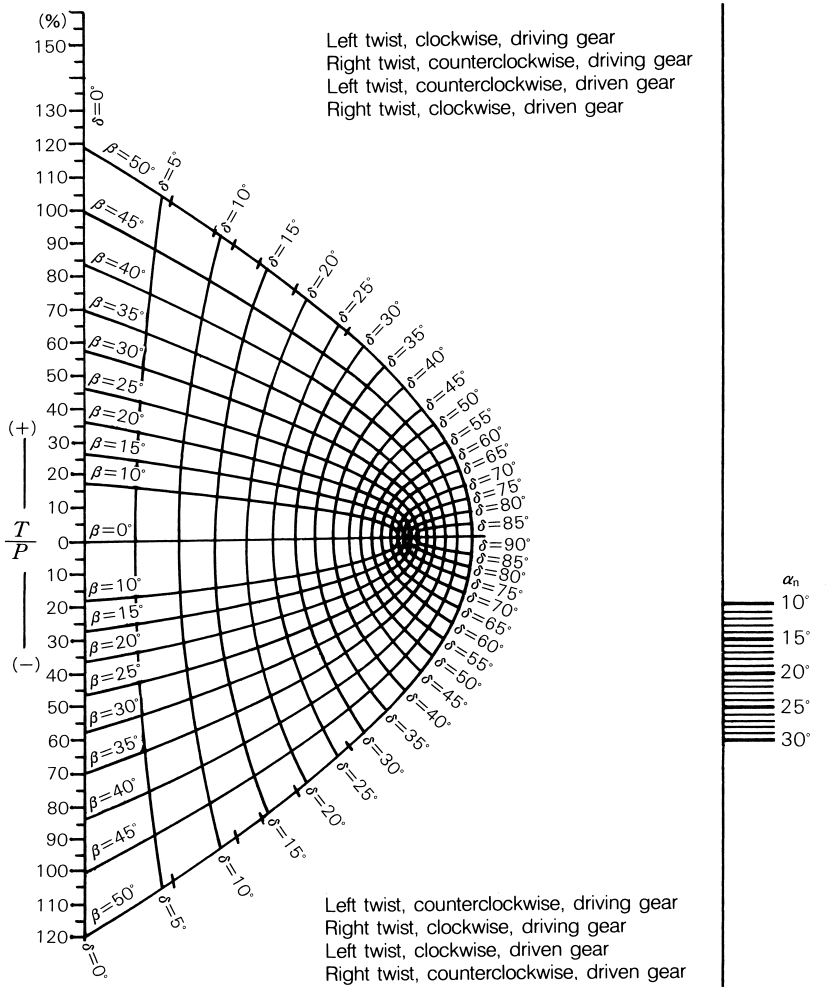
The next calculation diagram is used to determine the approximate value and direction of separating force S and thrust T.

[How To Use]
The method of determining the separating force S is shown. The thrust T can also be determined in a similar manner.

1. Take the gear normal pressure angle $\alpha_n$ from the vertical scale on the left side of the diagram.
2. Determine the intersection between the pitch cone angle $\delta$ and the twist angle $\beta$. Determine one point which is either above or below the $\beta = 0$ line according to the rotating direction and gear twist direction.
3. Draw a line connecting the two points and read the point at which the line cuts through the right vertical scale. This reading gives the ratio (S/P, %) of the separating force S to the tangential force P in percentage.




Calculation Diagram of Separating Force S




Calculation Diagram of Thrust T

### (5) Calculation of Load on Worm Gear

A worm gear is a kind of spigot gear, which can produce a high reduction ratio with small volume. The load at a meshing point of worm gears is calculated as shown in Table 4.17. Symbols of Table 4.17 are as follows:

i: Gear ratio $\left( i = \frac{Z_2}{Z_w} \right)$

$\eta$: Worm gear efficiency $\left[ \eta = \frac{\tan\gamma}{\tan(\gamma+\psi)} \right]$

$\gamma$ Advance angle $\left( \gamma = \tan^{-1}\frac{d_{p2}}{id_{p1}} \right)$

$\psi$: For the frictional angle, the value obtained

from $V_R = \frac{\pi d_{p1} n_1}{\cos\gamma} \times \frac{10^{-3}}{60}$

as shown in Fig. 4.57 is used.

When $V_R$ is 0.2 m/s or less, then use $\psi = 8°$.
When $V_R$ exceeds 6 m/s, use $\psi = 1°4'$.

$\alpha_n$ : Gear normal pressure angle
$\alpha_a$ : Shaft plane pressure angle
$Z_w$ : No. of threads (No. of teeth of worm gear)
$Z_2$ : No. of teeth of worm wheel
Subscript 1: For driving worm gear
Subscript 2: For driven worm gear

In a worm gear, there are four combinations of interaction at the meshing point as shown below depending on the twist directions and rotating directions of the worm gear.

The load on the bearing is obtained from the magnitude and direction of each component at the meshing point of the worm gears according to the method shown in Table 4.15 of Section 4.8.7 (1), Calculation of loads on spur, helical, and double-helical gears.

**Table 4.17**

| Force | Worm | Worm wheel |
|---|---|---|
| Tangential P | $\frac{9\,550\,000H}{n_1\left(\frac{d_{p1}}{2}\right)}$ .....(N)<br>$\frac{974\,000H}{n_1\left(\frac{d_{p1}}{2}\right)}$ .....{kgf} | $\frac{9\,550\,000Hi\eta}{n_1\left(\frac{d_{p2}}{2}\right)} = \frac{P_1\eta}{\tan\gamma} = \frac{P_1}{\tan(\gamma+\psi)}$ .....(N)<br>$\frac{974\,000Hi\eta}{n_1\left(\frac{d_{p2}}{2}\right)} = \frac{P_1\eta}{\tan\gamma} = \frac{P_1}{\tan(\gamma+\psi)}$ .....{kgf} |
| Thrust T | $\frac{9\,550\,000Hi\eta}{n_1\left(\frac{d_{p2}}{2}\right)} = \frac{P_1\eta}{\tan\gamma} = \frac{P_1}{\tan(\gamma+\psi)}$ .....(N)<br>$\frac{974\,000Hi\eta}{n_1\left(\frac{d_{p2}}{2}\right)} = \frac{P_1\eta}{\tan\gamma} = \frac{P_1}{\tan(\gamma+\psi)}$ .....{kgf} | $\frac{9\,550\,000H}{n_1\left(\frac{d_{p1}}{2}\right)}$ .....(N)<br>$\frac{974\,000H}{n_1\left(\frac{d_{p1}}{2}\right)}$ .....{kgf} |
| Separating S | $\frac{P_1\tan\alpha_n}{\sin(\gamma+\psi)} = \frac{P_1\tan\alpha_a}{\tan(\gamma+\psi)}$ .....(N), {kgf} | $\frac{P_1\tan\alpha_n}{\sin(\gamma+\psi)} = \frac{P_1\tan\alpha_a}{\tan(\gamma+\psi)}$ .....(N), {kgf} |

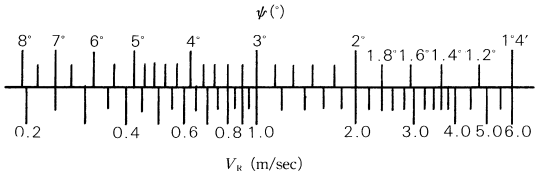
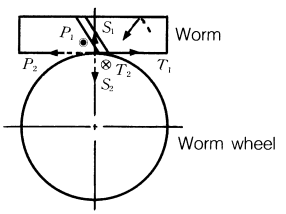
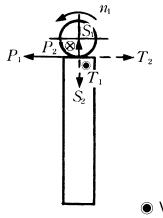



Fig. 4.57

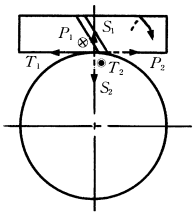





◉ Vertical upward on paper
⊗ Vertical downward on paper

Fig. 4.58 Right twist worm gear



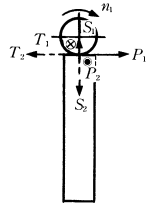
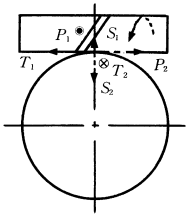




Fig. 4.59 Right twist worm gear (worm rotation is opposite of fig. 4.58)



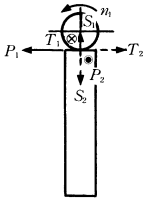
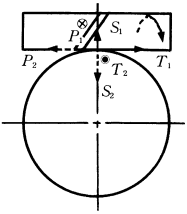




Fig. 4.60 Left twist worm gear



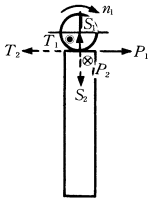
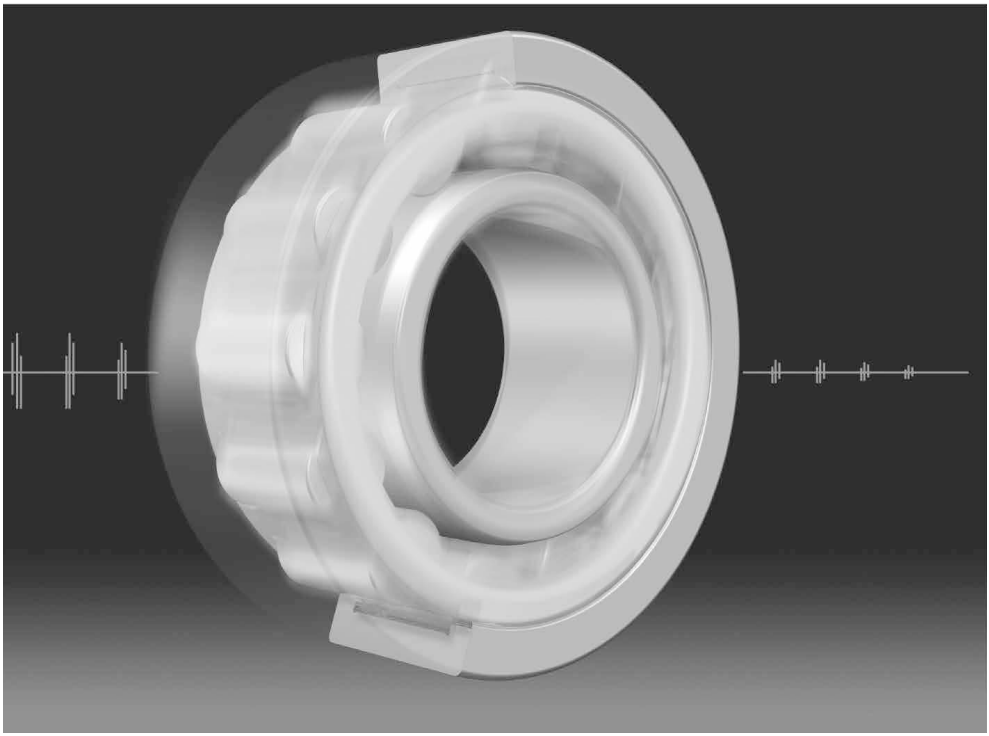




Fig. 4.61 Left twist worm gear (worm rotation is opposite of fig. 4.60)



## 5. SPEEDS


5.1 Limiting Speed (Grease/Oil) ..... A 098
5.1.1 Correction of Limiting Speed (Grease/Oil) ..... A 098
5.1.2 Limiting Speed (Grease/Oil) for Rubber Contact Seals for Ball Bearings ..... A 099
5.2 Thermal Reference Speed ..... A 099
5.3 Limiting Speed (Mechanical) ..... A 099
5.4 Technical Data ..... A 100
5.4.1 Rotation and Revolution Speed of Rolling Element ..... A 100

# 5. Speeds

In this catalog, NSK uses four definitions of speed shown in Table 5.1.

**Table 5.1 Overview of Speeds**

| Speeds | Overview | Applicable lubrication methods |
|---|---|---|
| Limiting Speed (Grease) | Empirically obtained and comprehensive bearing limiting speed in grease lubrication. | Grease lubrication |
| Limiting Speed (Oil) | Empirically obtained and comprehensive bearing limiting speed in oil bath lubrication. | Oil bath lubrication |
| Thermal Reference Speed (1) | Rotational speed at which equilibrium is reached between the heat generated by the bearing and the heat flow emitted through the shaft and housing under the reference conditions defined by ISO 15312. One among various criteria showing the suitability for operation at high speed. | Oil bath lubrication when subject to reference conditions outlined in ISO 15312 |
| Limiting Speed (Mechanical) (1) | Mechanical and kinematic limiting speed achievable under ideal conditions for lubrication, heat dissipation and temperature. | e.g. Properly designed and controlled forced circulation oil lubrication |

Note (1) Thermal reference speeds and limiting speed (mechanical) are listed only in the tables of single row cylindrical roller bearings and spherical roller bearings.

## 5.1 Limiting Speed (Grease/Oil)

When bearings are operating, the higher the speed, the higher the bearing temperature due to friction. The limiting speed is the empirically obtained value for the maximum speed at which bearings can be continuously operated without generating excessive heat or failing due to seizure. Consequently, the limiting speed of bearings varies depending on such factors as bearing type and size, cage form and material, load, lubricating method, and heat dissipating method including the design of the bearing's surroundings.

The limiting speed (grease) and limiting speed (oil) in the bearing tables are applicable to bearings of standard design and subjected to normal loads, i.e. $C/P \geqq 12$ and $F_a/F_r \leqq 0.2$ approximately. The limiting speed (oil) listed in the bearing tables is for conventional oil bath lubrication. Some types of lubricants are not suitable for high speed, even though they may be markedly superior in other respects. When speeds are more than 70 percent of the listed limiting speed (grease) or limiting speed (oil), it is necessary to select a grease or oil which has good high speed characteristics. (Refer to)

Table 11.2 Grease Properties (Pages A236 and A237)
Table 11.5 Example of Selection of Lubricant for Bearing Operating Conditions (Page A239)
Table 11.6 Brands and Properties of Lubricating Grease (Pages A240 and A241)

### 5.1.1 Correction of Limiting Speed (Grease/Oil)

When the bearing load P exceeds 8 % of the basic load rating C, or when the axial load Fa exceeds 20 % of the radial load $F_r$, the limiting speed (grease) and limiting speed (oil) must be corrected by multiplying the limiting speed value found in the bearing tables by the correction factor shown in Figs. 5.1 and 5.2. When the required speed exceeds the limiting speed (oil) of the desired bearing, then the accuracy grade, internal clearance, cage type and material, lubrication, etc. must be carefully studied in order to select a bearing capable of the required speed. In such a case, forced-circulation oil lubrication, jet lubrication, oil mist lubrication, or oil-air lubrication must be used. If all these conditions are considered, a corrected maximum permissible speed may be obtained by multiplying the limiting speed (oil) found in the bearing tables by the correction factor shown in table 5.2. It is recommended that NSK be consulted regarding high speed applications.

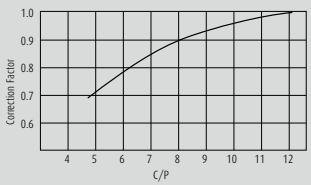



Fig. 5.1 Limiting Speed Correction Factor Variation with Load Ratio

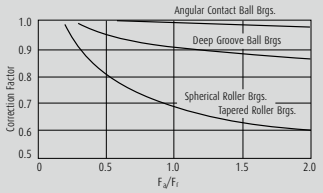



Fig. 5.2 Limiting Speed Correction Factor for Combined Radial and Axial Loads

**Table 5.2 Limiting Speed Correction Factor for High-Speed Applications**

| Bearing Types | Correction Factor |
|---|---|
| Needle Roller Brgs. (except broad width) | 2 |
| Tapered Roller Brgs. | 2 |
| Deep Grooove Ball Brgs. | 2.5 |
| Angular Contact Ball Brgs. (except matched bearings) | 1.5 |

### 5.1.2 Limiting Speed (Grease/Oil) for Rubber Contact Seals for Ball Bearings

The maximum permissible speed for contact rubber sealed bearings (DDU type) is determined mainly by the sliding surface speed of the inner circumference of the seal. Values for the limiting speed are listed in the bearing tables.

## 5.2 Thermal Reference Speed

The thermal reference speed is the rotational speed at which equilibrium is reached between the heat generated by the bearing and the heat flow emitted through the shaft and housing under the reference conditions defined by ISO 15312. It is one among various criteria showing the suitability for operation at high speed. The below reference conditions are defined by ISO 15312.

- -Outer-ring fixed, Inner-ring rotating
- -Mean ambient temperature 20 degrees C
- -Mean bearing temperature at the outer ring 70 degrees C
- -Load on radial bearings 0.05 Cor
- -Oil bath lubrication
- -Lubricant ISO VG32 (radial bearings)
- -Normal bearing internal clearance

The heat dissipation through the housing and shaft can be obtained from Fig.5.3. In Fig.5.3, $A_r$ ($mm^2$) is the heat emitting reference surface area. ISO defines $A_r$ as the total area of the bearing's inner ring bore surface and outer ring outside surface (radial bearings), and $q_r$ ($W/mm^2$) as the heat flow density. The heat dissipation is calculated by multiplying the bearing seating surface area ($A_r$) by the heat flow density ($q_r$).

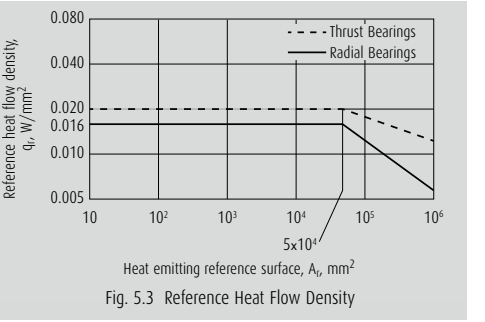



Fig. 5.3 Reference Heat Flow Density

## 5.3 Limiting Speed (Mechanical)

Limiting speed (mechanical) is the mechanical and kinematic limiting speed of bearings achievable under ideal conditions for lubrication, heat dissipation and temperature, such as with properly designed and controlled forced circulation oil lubrication for high speed conditions.
The limiting speed (mechanical) considers the sliding speed and contact forces between the various bearing elements, the centrifugal and gyratory forces, etc. The values in the tables are applicable to bearings of standard design and subjected to normal loads (C/P = 12 approximately).

In the bearing tables of single row cylindrical roller bearings and spherical roller bearings, the thermal reference speeds, limiting speeds (mechanical) and limiting speeds(grease) are listed. In the bearing tables of the other bearing types, the limiting speeds (grease) and limiting speeds (oil) are listed.

## 5.4 Technical Data

### 5.4.1 Rotation and Revolution Speed of Rolling Element

When the rolling element rotates without slip between bearing rings, the distance which the rolling element rolls on the inner ring raceway is equal to that on the outer ring raceway. This fact allows establishment of a relationship among rolling speed $\eta_i$ and $\eta_e$ of the inner and outer rings and the number of rotation $n_a$ of rolling elements.

The revolution speed of the rolling element can be determined as the arithmetic mean of the circumferential speed on the inner ring raceway and that on the outer ring raceway (generally with either the inner or outer ring being stationary). The rotation and revolution of the rolling element can be related as expressed by Equations (5.1) through (5.4).

No. of rotation

$$\eta_a = \left( \frac{D_{pw}}{D_w} - \frac{D_w \cos^2\alpha}{D_{pw}} \right) \frac{\eta_e - \eta_i}{2} \quad (\text{min}^{-1}) \cdots\cdots (\mathbf{5.1})$$

Rotational circumferential speed

$$V_a = \frac{\pi D_w}{60 \times 10^3} \left( \frac{D_{pw}}{D_w} - \frac{D_w \cos^2\alpha}{D_{pw}} \right) \frac{\eta_e - \eta_i}{2} \quad (\text{m/s}) \cdots\cdots (\mathbf{5.2})$$

No. of revolutions (No. of cage rotation)

$$\eta_c = \left( 1 - \frac{D_w \cos\alpha}{D_{pw}} \right) \frac{\eta_i}{2} + \left( 1 + \frac{D_w \cos\alpha}{D_{pw}} \right) \frac{\eta_e}{2} \quad (\text{min}^{-1}) \cdots\cdots (\mathbf{5.3})$$

Revolutional circumferential speed
(cage speed at rolling element pitch diameter)

$$V_c = \frac{\pi D_{pw}}{60 \times 10^3} \left[ \left( 1 - \frac{D_w \cos\alpha}{D_{pw}} \right) \frac{\eta_i}{2} + \left( 1 + \frac{D_w \cos\alpha}{D_{pw}} \right) \frac{\eta_e}{2} \right] \quad (\text{m/s}) \cdots\cdots (\mathbf{5.4})$$

where, $D_{pw}$ : Pitch diameter of rolling elements (mm)
$D_w$ : Diameter of rolling element (mm)
$\alpha$ : Contact angle (°)
$\eta_e$ : Outer ring speed (min$^{-1}$)
$\eta_i$ : Inner ring speed (min$^{-1}$)

The rotation and revolution of the rolling element is shown in Table 5.3 for inner ring rotating ($\eta_e = 0$) and outer ring rotating ($\eta_i = 0$) respectively at $0° \leqq \alpha < 90°$ and at $\alpha = 90°$. As an example, Table 5.4 shows the rotation speed $\eta_a$ and revolution speed $\eta_c$ of the rolling element during rotating of the inner ring of ball bearings 6210 and 6310.

| Contact angle | Rotation/revolution speed |
|---|---|
| $0° \leqq \alpha < 90°$ | $\eta_a$ (min$^{-1}$) |
| | $v_a$ (m/s) |
| | $\eta_c$ (min$^{-1}$) |
| | $v_c$ (m/s) |
| $\alpha = 90°$ | $\eta_a$ (min$^{-1}$) |
| | $v_a$ (m/s) |
| | $\eta_c$ (min$^{-1}$) |
| | $v_c$ (m/s) |

## Table 5.4 $n_a$ and $n_c$ for Ball Bearings 6210 and 6310

| Ball bearing | $\gamma$ | $\eta_a$ | $\eta_c$ |
|---|---|---|---|
| 6210 | 0.181 | $-2.67\eta_i$ | $0.41\eta_i$ |
| 6310 | 0.232 | $-2.04\eta_i$ | $0.38\eta_i$ |

Remark $\gamma = \dfrac{D_w \cos\alpha}{D_{pw}}$

5

## Table 5.3 Rolling Element's Rotation Speed $\eta_a$, Rotational Circumferential Speed $v_a$, Revolution Speed $\eta_c$, and Revolutional Circumferential Speed $v_c$

| | Inner ring rolling ($n_e$=0) | Outer ring rolling ($n_i$=0) |
|---|---|---|
| | $-\left(\frac{1}{\gamma} - \gamma\right)\frac{\eta_i}{2}\cdot\cos\alpha$ | $\left(\frac{1}{\gamma} - \gamma\right)\frac{\eta_e}{2}\cdot\cos\alpha$ |
| | $\frac{\pi D_w}{60 \times 10^3}\eta_a$ | |
| | $(1 - \gamma)\frac{\eta_i}{2}$ | $(1 + \gamma)\frac{\eta_e}{2}$ |
| | $\frac{\pi D_{pw}}{60 \times 10^3}n_c$ | |
| | $-\frac{1}{\gamma}\cdot\frac{\eta_i}{2}$ | $\frac{1}{\gamma}\cdot\frac{\eta_e}{2}$ |
| | $\frac{\pi D_w}{60 \times 10^3}\eta_a$ | |
| | $\frac{\eta_i}{2}$ | $\frac{\eta_e}{2}$ |
| | $\frac{\pi D_{pw}}{60 \times 10^3}\eta_c$ | |

Reference
1. ±: The "+" symbol indicates clockwise rotation while the "-" symbol indicates counterclockwise rotation.
2. $\gamma = \dfrac{D_w \cos\alpha}{D_{pw}}$ $(0° \leqq \alpha < 90°)$, $\gamma \dfrac{D_w}{D_{pw}}$ $(\alpha = 90°)$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## 6. BOUNDARY DIMENSIONS AND IDENTIFYING NUMBERS FOR BEARINGS


6.1 Boundary Dimensions and Dimensions of Snap Ring Grooves ..... A 104
6.1.1 Boundary Dimensions ..... A 104
6.1.2 Dimensions of Snap Ring Grooves and Locating Snap Rings ..... A 104
6.2 Formulation of Bearing Numbers ..... A 120

## 6.1 Boundary Dimensions and Dimensions of Snap Ring Grooves

### 6.1.1 Boundary Dimensions

The boundary dimensions of rolling bearings, which are shown in Figs. 6.1 through 6.5, are the dimensions that define their external geometry. They include bore diameter d, outside diameter D, width B, bearing width (or height) T, chamfer dimension r, etc. It is necessary to know all of these dimensions when mounting a bearing on a shaft and in a housing. These boundary dimensions have been internationally standardized (ISO15) and adopted by JIS B 1512 (Boundary Dimensions of Rolling Bearings).

The boundary dimensions and dimension series of radial bearings, tapered roller bearings, and thrust bearings are listed in Table 6.1 to 6.3 (Pages A106 to A115).

In these boundary dimension tables, for each bore number, which prescribes the bore diameter, other boundary dimensions are listed for each diameter series and dimension series. A very large number of series are possible; however, not all of them are commercially available so more can be added in the future. Across the top of each bearing table (6.1 to 6.3), representative bearing types and series symbols are shown (refer to Table 6.5, Bearing Series Symbols, Page A121).

The relative cross-sectional dimensions of radial bearings (except tapered roller bearings) and thrust bearings for the various series classifications are shown in Figs. 6.6 and 6.7 respectively.

### 6.1.2 Dimensions of Snap Ring Grooves and Locating Snap Rings

The dimensions of Snap ring grooves in the outer surfaces of bearings are specified by ISO 464. Also, the dimensions and accuracy of the locating snap rings themselves are specified by ISO 464. The dimensions of snap ring grooves and locating snap ring for bearings of diameter series 8, 9, 0, 2, 3, and 4, are shown in Table 6.4 (Pages A116 to A119).

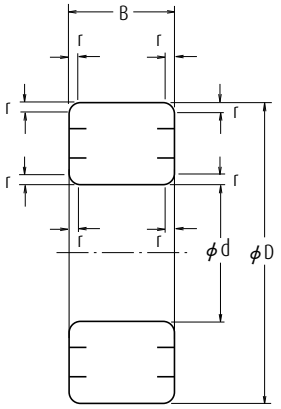



Fig. 6.1 Boundary Dimensions of Radial Ball and Roller Bearings

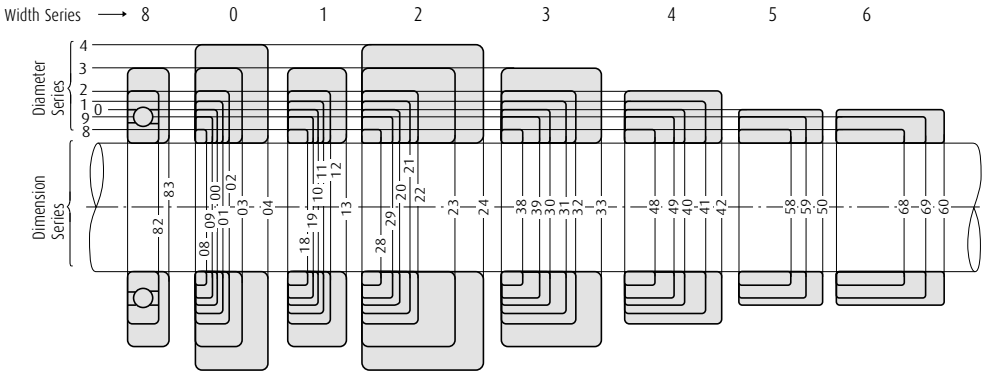



Fig. 6.6 Comparison of Cross Sections of Radial Bearings (except Tapered Roller Bearings) for various Dimensional Series

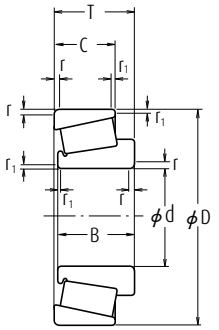



Fig. 6.2 Tapered Roller Bearings

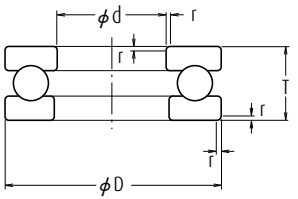



Fig. 6.3 Single-Direction Thrust Ball Bearings

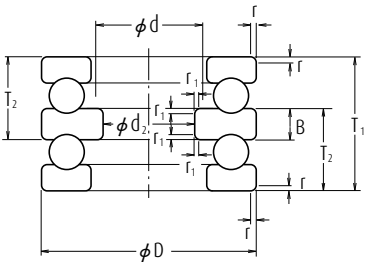



Fig. 6.4 Double-Direction Thrust Ball Bearings

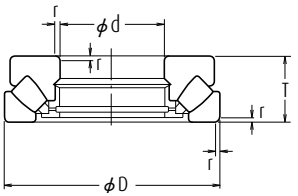



Fig. 6.5 Spherical Thrust Roller Bearings

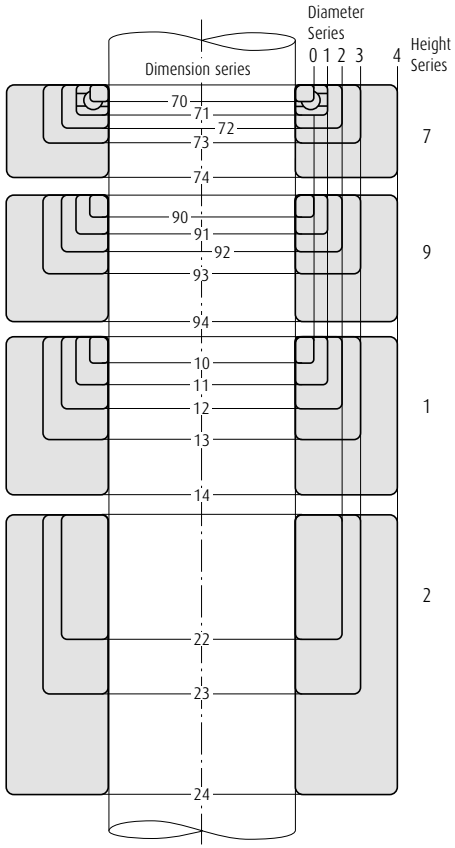



Fig. 6.7 Comparison of Cross Sections of Thrust Bearings (except Diameter Series 5) for Various Dimension Series

6

## Table 6.1 Boundary Dimensions of Radial Bearings (except Tapered Roller Bearings) —1—

Units: mm

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Single-Row Ball Brgs. | | | | | | | | 68 | | | | | | | | | | 69<br>79 | | | | | | | | | | 160 | 60<br>70 | | | | | | | |
| Double-Row Ball Brgs. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cylindrical Roller Brgs. | | | | | | | N28 | NN38 | NN48 | | | | | | | | N19 | N29 | NN39 | NN49 | | | | | | | | N10 | N20 | NN30 | NN40 | | | | | |
| Needle Roller Brgs. | | | | | | | | | NA48 | | | | | | | | | | | NA49 | NA59 | NA69 | | | | | | | | | | | | | | |
| Spherical Roller Brgs. | | | | | | | | | | | | | | | | | | | 239 | | | | | | | | | | | 230 | 240 | | | | | |

| Bore Number | d | Diameter Series 7 | | | | | Diameter Series 8 | | | | | | | | | Diameter Series 9 | | | | | | | | | | Diameter Series 0 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimension Series | | | | | Dimension Series | | | | | | | | | Dimension Series | | | | | | | | | | Dimension Series | | | | | | | | | |
| | | D | 17 | 27 | 37 | 17~37 | D | 08 | 18 | 28 | 38 | 48 | 58 | 68 | 08 | 18~68 | D | 09 | 19 | 29 | 39 | 49 | 59 | 69 | 09 | 19~39 | 49~69 | D | 00 | 10 | 20 | 30 | 40 | 50 | 60 | 00 | 10~60 |
| | | | B | | | r (min.) | | B | | | | | | | r (min.) | | | B | | | | | | r (min.) | | | B | | | | | | | r (min.) | |
| – | 0.6 | 2 | 0.8 | – | – | 0.05 | 2.5 | – | 1 | – | 1.4 | – | – | – | – | 0.05 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 1 | 1 | 2.5 | 1 | – | – | 0.05 | 3 | – | 1 | – | 1.5 | – | – | – | – | 0.05 | 4 | – | 1.6 | – | 2.3 | – | – | – | – | 0.1 | – | – | – | – | – | – | – | – | – | – | – |
| – | 1.5 | 3 | 1 | – | 1.8 | 0.05 | 4 | – | 1.2 | – | 2 | – | – | – | – | 0.05 | 5 | – | 2 | – | 2.6 | – | – | – | – | 0.15 | – | 6 | – | 2.5 | – | 3 | – | – | – | – | 0.15 |
| 2 | 2 | 4 | 1.2 | – | 2 | 0.05 | 5 | – | 1.5 | – | 2.3 | – | – | – | – | 0.08 | 6 | – | 2.3 | – | 3 | – | – | – | – | 0.15 | – | 7 | – | 2.8 | – | 3.5 | – | – | – | – | 0.15 |
| – | 2.5 | 5 | 1.5 | – | 2.3 | 0.08 | 6 | – | 1.8 | – | 2.6 | – | – | – | – | 0.08 | 7 | – | 2.5 | – | 3.5 | – | – | – | – | 0.15 | – | 8 | – | 2.8 | – | 4 | – | – | – | – | 0.15 |
| 3 | 3 | 6 | 2 | 2.5 | 3 | 0.08 | 7 | – | 2 | – | 3 | – | – | – | – | 0.1 | 8 | – | 3 | – | 4 | – | – | – | – | 0.15 | – | 9 | – | 3 | – | 5 | – | – | – | – | 0.15 |
| 4 | 4 | 7 | 2 | 2.5 | 3 | 0.08 | 9 | – | 2.5 | 3.5 | 4 | – | – | – | – | 0.1 | 11 | – | 4 | – | 5 | – | – | – | – | 0.15 | – | 12 | – | 4 | – | 6 | – | – | – | – | 0.2 |
| 5 | 5 | 8 | 2 | 2.5 | 3 | 0.08 | 11 | – | 3 | 4 | 5 | – | – | – | – | 0.15 | 13 | – | 4 | – | 6 | 10 | – | – | – | 0.2 | 0.15 | 14 | – | 5 | – | 7 | – | – | – | – | 0.2 |
| 6 | 6 | 10 | 2.5 | 3 | 3.5 | 0.1 | 13 | – | 3.5 | 5 | 6 | – | – | – | – | 0.15 | 15 | – | 5 | – | 7 | 10 | – | – | – | 0.2 | 0.15 | 17 | – | 6 | – | 9 | – | – | – | – | 0.3 |
| 7 | 7 | 11 | 2.5 | 3 | 3.5 | 0.1 | 14 | – | 3.5 | 5 | 6 | – | – | – | – | 0.15 | 17 | – | 5 | – | 7 | 10 | – | – | – | 0.3 | 0.15 | 19 | – | 6 | 8 | 10 | – | – | – | – | 0.3 |
| 8 | 8 | 12 | 2.5 | – | 3.5 | 0.1 | 16 | – | 4 | 5 | 6 | 8 | – | – | – | 0.2 | 19 | – | 6 | – | 9 | 11 | – | – | – | 0.3 | 0.2 | 22 | – | 7 | 9 | 11 | 14 | 19 | 25 | – | 0.3 |
| 9 | 9 | 14 | 3 | – | 4.5 | 0.1 | 17 | – | 4 | 5 | 6 | 8 | – | – | – | 0.2 | 20 | – | 6 | – | 9 | 11 | – | – | – | 0.3 | 0.3 | 24 | – | 7 | 10 | 12 | 15 | 20 | 27 | – | 0.3 |
| 00 | 10 | 15 | 3 | – | 4.5 | 0.1 | 19 | – | 5 | 6 | 7 | 9 | – | – | – | 0.3 | 22 | – | 6 | 8 | 10 | 13 | 16 | 22 | – | 0.3 | 0.3 | 26 | – | 8 | 10 | 12 | 16 | 21 | 29 | – | 0.3 |
| 01 | 12 | 18 | 4 | – | 5 | 0.2 | 21 | – | 5 | 6 | 7 | 9 | – | – | – | 0.3 | 24 | – | 6 | 8 | 10 | 13 | 16 | 22 | – | 0.3 | 0.3 | 28 | 7 | 8 | 10 | 12 | 16 | 21 | 29 | 0.3 | 0.3 |
| 02 | 15 | 21 | 4 | – | 5 | 0.2 | 24 | – | 5 | 6 | 7 | 9 | – | – | – | 0.3 | 28 | – | 7 | 8.5 | 10 | 13 | 18 | 23 | – | 0.3 | 0.3 | 32 | 8 | 9 | 11 | 13 | 17 | 23 | 30 | 0.3 | 0.3 |
| 03 | 17 | 23 | 4 | – | 5 | 0.2 | 26 | – | 5 | 6 | 7 | 9 | – | – | – | 0.3 | 30 | – | 7 | 8.5 | 10 | 13 | 18 | 23 | – | 0.3 | 0.3 | 35 | 8 | 10 | 12 | 14 | 18 | 24 | 32 | 0.3 | 0.3 |
| 04 | 20 | 27 | 4 | – | 5 | 0.2 | 32 | 4 | 7 | 8 | 10 | 12 | 16 | 22 | 0.3 | 0.3 | 37 | 7 | 9 | 11 | 13 | 17 | 23 | 30 | 0.3 | 0.3 | 0.3 | 42 | 8 | 12 | 14 | 16 | 22 | 30 | 40 | 0.3 | 0.6 |
| /22 | 22 | – | – | – | – | – | 34 | 4 | 7 | – | 10 | – | 16 | 22 | 0.3 | 0.3 | 39 | 7 | 9 | 11 | 13 | 17 | 23 | 30 | 0.3 | 0.3 | 0.3 | 44 | 8 | 12 | 14 | 16 | 22 | 30 | 40 | 0.3 | 0.6 |
| 05 | 25 | 32 | 4 | – | 5 | 0.2 | 37 | 4 | 7 | 8 | 10 | 12 | 16 | 22 | 0.3 | 0.3 | 42 | 7 | 9 | 11 | 13 | 17 | 23 | 30 | 0.3 | 0.3 | 0.3 | 47 | 8 | 12 | 14 | 16 | 22 | 30 | 40 | 0.3 | 0.6 |
| /28 | 28 | – | – | – | – | – | 40 | 4 | 7 | – | 10 | – | 16 | 22 | 0.3 | 0.3 | 45 | 7 | 9 | 11 | 13 | 17 | 23 | 30 | 0.3 | 0.3 | 0.3 | 52 | 8 | 12 | 15 | 18 | 24 | 32 | 43 | 0.3 | 0.6 |
| 06 | 30 | 37 | 4 | – | 5 | 0.2 | 42 | 4 | 7 | 8 | 10 | 12 | 16 | 22 | 0.3 | 0.3 | 47 | 7 | 9 | 11 | 13 | 17 | 23 | 30 | 0.3 | 0.3 | 0.3 | 55 | 9 | 13 | 16 | 19 | 25 | 34 | 45 | 0.3 | 1 |
| /32 | 32 | – | – | – | – | – | 44 | 4 | 7 | – | 10 | – | 16 | 22 | 0.3 | 0.3 | 52 | 7 | 10 | 13 | 15 | 20 | 27 | 36 | 0.3 | 0.6 | 0.6 | 58 | 9 | 13 | 16 | 20 | 26 | 35 | 47 | 0.3 | 1 |
| 07 | 35 | – | – | – | – | – | 47 | 4 | 7 | 8 | 10 | 12 | 16 | 22 | 0.3 | 0.3 | 55 | 7 | 10 | 13 | 15 | 20 | 27 | 36 | 0.3 | 0.6 | 0.6 | 62 | 9 | 14 | 17 | 20 | 27 | 36 | 48 | 0.3 | 1 |
| 08 | 40 | – | – | – | – | – | 52 | 4 | 7 | 8 | 10 | 12 | 16 | 22 | 0.3 | 0.3 | 62 | 8 | 12 | 14 | 16 | 22 | 30 | 40 | 0.3 | 0.6 | 0.6 | 68 | 9 | 15 | 18 | 21 | 28 | 38 | 50 | 0.3 | 1 |
| 09 | 45 | – | – | – | – | – | 58 | 4 | 7 | 8 | 10 | 13 | 18 | 23 | 0.3 | 0.3 | 68 | 8 | 12 | 14 | 16 | 22 | 30 | 40 | 0.3 | 0.6 | 0.6 | 75 | 10 | 16 | 19 | 23 | 30 | 40 | 54 | 0.6 | 1 |
| 10 | 50 | – | – | – | – | – | 65 | 5 | 7 | 10 | 12 | 15 | 20 | 27 | 0.3 | 0.3 | 72 | 8 | 12 | 14 | 16 | 22 | 30 | 40 | 0.3 | 0.6 | 0.6 | 80 | 10 | 16 | 19 | 23 | 30 | 40 | 54 | 0.6 | 1 |
| 11 | 55 | – | – | – | – | – | 72 | 7 | 9 | 11 | 13 | 17 | 23 | 30 | 0.3 | 0.3 | 80 | 9 | 13 | 16 | 19 | 25 | 34 | 45 | 0.3 | 1 | 1 | 90 | 11 | 18 | 22 | 26 | 35 | 46 | 63 | 0.6 | 1.1 |
| 12 | 60 | – | – | – | – | – | 78 | 7 | 10 | 12 | 14 | 18 | 24 | 32 | 0.3 | 0.3 | 85 | 9 | 13 | 16 | 19 | 25 | 34 | 45 | 0.3 | 1 | 1 | 95 | 11 | 18 | 22 | 26 | 35 | 46 | 63 | 0.6 | 1.1 |
| 13 | 65 | – | – | – | – | – | 85 | 7 | 10 | 13 | 15 | 20 | 27 | 36 | 0.3 | 0.6 | 90 | 9 | 13 | 16 | 19 | 25 | 34 | 45 | 0.3 | 1 | 1 | 100 | 11 | 18 | 22 | 26 | 35 | 46 | 63 | 0.6 | 1.1 |
| 14 | 70 | – | – | – | – | – | 90 | 8 | 10 | 13 | 15 | 20 | 27 | 36 | 0.3 | 0.6 | 100 | 10 | 16 | 19 | 23 | 30 | 40 | 54 | 0.6 | 1 | 1 | 110 | 13 | 20 | 24 | 30 | 40 | 54 | 71 | 0.6 | 1.1 |
| 15 | 75 | – | – | – | – | – | 95 | 8 | 10 | 13 | 15 | 20 | 27 | 36 | 0.3 | 0.6 | 105 | 10 | 16 | 19 | 23 | 30 | 40 | 54 | 0.6 | 1 | 1 | 115 | 13 | 20 | 24 | 30 | 40 | 54 | 71 | 0.6 | 1.1 |
| 16 | 80 | – | – | – | – | – | 100 | 8 | 10 | 13 | 15 | 20 | 27 | 36 | 0.3 | 0.6 | 110 | 10 | 16 | 19 | 23 | 30 | 40 | 54 | 0.6 | 1 | 1 | 125 | 14 | 22 | 27 | 34 | 45 | 60 | 80 | 0.6 | 1.1 |
| 17 | 85 | – | – | – | – | – | 110 | 9 | 13 | 16 | 19 | 25 | 34 | 45 | 0.3 | 1 | 120 | 11 | 18 | 22 | 26 | 35 | 46 | 63 | 0.6 | 1.1 | 1.1 | 130 | 14 | 22 | 27 | 34 | 45 | 60 | 80 | 0.6 | 1.1 |
| 18 | 90 | – | – | – | – | – | 115 | 9 | 13 | 16 | 19 | 25 | 34 | 45 | 0.3 | 1 | 125 | 11 | 18 | 22 | 26 | 35 | 46 | 63 | 0.6 | 1.1 | 1.1 | 140 | 16 | 24 | 30 | 37 | 50 | 67 | 90 | 1 | 1.5 |
| 19 | 95 | – | – | – | – | – | 120 | 9 | 13 | 16 | 19 | 25 | 34 | 45 | 0.3 | 1 | 130 | 11 | 18 | 22 | 26 | 35 | 46 | 63 | 0.6 | 1.1 | 1.1 | 145 | 16 | 24 | 30 | 37 | 50 | 67 | 90 | 1 | 1.5 |
| 20 | 100 | – | – | – | – | – | 125 | 9 | 13 | 16 | 19 | 25 | 34 | 45 | 0.3 | 1 | 140 | 13 | 20 | 24 | 30 | 40 | 54 | 71 | 0.6 | 1.1 | 1.1 | 150 | 16 | 24 | 30 | 37 | 50 | 67 | 90 | 1 | 1.5 |

| | | |

## Table 6.1 Boundary Dimensions of Radial Bearings (except Tapered Roller Bearings) — 2 —

Units: mm

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Single-Row Ball Brgs. | | | | | | | | | | | 62<br>72 | | 622 | 632 | | | | | | 63<br>73 | | 623 | 633 | | | | 64<br>74 | | |
| Double-Row Ball Brgs. | | | | | | | | | | | 12 | | 42<br>22 | 52<br>53 | | | | | | 13 | | 43<br>23 | 53<br>33 | | | | 104 | | |
| Cylindrical Roller Brgs. | | | | NN 31 | | | | | | | N 2 | | N 22 | N 32 | | | | | | N 3 | | N 23 | N 33 | | | | N 4 | | |
| Needle Roller Brgs. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Spherical Roller Brgs. | | | | 231 | 241 | | | | | | | | 222 | 232 | | | | | | 213 | | 223 | | | | | | | |

| Bore Number | d | Diameter Series 1 | | | | | | | | Diameter Series 2 | | | | | | | | | Diameter Series 3 | | | | | | | | Diameter Series 4 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimension Series | | | | | | | | Dimension Series | | | | | | | | | Dimension Series | | | | | | | | Dimension Series | | | |
| | | D | 01 | 11 | 21 | 31 | 41 | 01 | 11~41 | D | 82 | 02 | 12 | 22 | 32 | 42 | 82 | 02~42 | D | 83 | 03 | 13 | 23 | 33 | 83 | 03~33 | D | 04 | 24 | 04~24 |
| | | B | | | | | | r (min.) | | B | | | | | | r (min.) | | B | | | | | | r (min.) | | B | | r (min.) | |
| – | 0.6 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 1 | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| – | 1.5 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 2 | 2 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| – | 2.5 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 3 | 3 | – | – | – | – | – | – | – | – | 10 | 2.5 | 4 | – | – | 5 | – | 0.1 | 0.15 | 13 | – | 5 | – | – | 7 | – | 0.2 | – | – | – | – |
| 4 | 4 | – | – | – | – | – | – | – | – | 13 | 3 | 5 | – | – | 7 | – | 0.15 | 0.2 | 16 | – | 5 | – | – | 9 | – | 0.3 | – | – | – | – |
| 5 | 5 | – | – | – | – | 7 | – | – | – | 16 | 3.5 | 5 | – | – | 8 | – | 0.15 | 0.3 | 19 | – | 6 | – | – | 10 | – | 0.3 | – | – | – | – |
| 6 | 6 | – | – | – | 8 | 10 | – | – | – | 19 | 4 | 6 | – | – | 10 | – | 0.2 | 0.3 | 22 | – | 7 | – | 11 | 13 | – | 0.3 | – | – | – | – |
| 7 | 7 | – | – | – | 9 | 11 | 14 | – | – | 22 | 5 | 7 | – | – | 11 | – | 0.3 | 0.3 | 26 | – | 9 | – | 13 | 15 | – | 0.3 | – | – | – | – |
| 8 | 8 | – | – | – | 10 | 12 | 15 | – | – | 24 | 5 | 8 | – | – | 12 | – | 0.3 | 0.3 | 28 | – | 9 | – | 13 | 15 | – | 0.3 | 30 | 10 | 14 | 0.6 |
| 9 | 9 | – | – | – | 10 | 12 | 16 | – | – | 26 | 6 | 8 | – | – | 13 | – | 0.3 | 0.3 | 30 | – | 10 | – | 14 | 16 | – | 0.6 | 32 | 11 | 15 | 0.6 |
| 00 | 10 | – | – | – | 12 | 14 | 18 | – | – | 30 | 7 | 9 | – | 14 | 14.3 | – | 0.3 | 0.6 | 35 | 9 | 11 | – | 17 | 19 | 0.3 | 0.6 | 37 | 12 | 16 | 0.6 |
| 01 | 12 | – | – | – | 12 | 14 | 18 | – | – | 32 | 7 | 10 | – | 14 | 15.9 | – | 0.3 | 0.6 | 37 | 9 | 12 | – | 17 | 19 | 0.3 | 1 | 42 | 13 | 19 | 1 |
| 02 | 15 | – | – | – | 12 | 14 | 18 | – | – | 35 | 8 | 11 | – | 14 | 15.9 | 20 | 0.3 | 0.6 | 42 | 9 | 13 | – | 17 | 19 | 0.3 | 1 | 52 | 15 | 24 | 1.1 |
| 03 | 17 | – | – | – | 13 | 15 | 20 | – | – | 40 | 8 | 12 | – | 16 | 17.5 | 22 | 0.3 | 0.6 | 47 | 10 | 14 | – | 19 | 22.2 | 0.6 | 1 | 62 | 17 | 29 | 1.1 |
| 04 | 20 | – | – | – | 15 | 18 | 24 | – | – | 47 | 9 | 14 | – | 18 | 20.6 | 27 | 0.3 | 1 | 52 | 10 | 15 | – | 21 | 22.2 | 0.6 | 1.1 | 72 | 19 | 33 | 1.1 |
| /22 | 22 | – | – | – | 16 | 19 | 25 | – | – | 50 | 9 | 14 | – | 18 | 20.6 | 27 | 0.3 | 1 | 56 | 11 | 16 | – | 21 | 25 | 0.6 | 1.1 | – | – | – | – |
| 05 | 25 | – | – | – | 16 | 19 | 25 | – | – | 52 | 10 | 15 | – | 18 | 20.6 | 27 | 0.3 | 1 | 62 | 12 | 17 | – | 24 | 25.4 | 0.6 | 1.1 | 80 | 21 | 36 | 1.5 |
| /28 | 28 | – | – | – | 17 | 20 | 27 | – | – | 58 | 10 | 16 | – | 19 | 23 | 30 | 0.6 | 1 | 68 | 13 | 18 | – | 24 | 30 | 0.6 | 1.1 | – | – | – | – |
| 06 | 30 | – | – | – | 18 | 21 | 28 | – | – | 62 | 10 | 16 | – | 20 | 23.8 | 32 | 0.6 | 1 | 72 | 13 | 19 | – | 27 | 30.2 | 0.6 | 1.1 | 90 | 23 | 40 | 1.5 |
| /32 | 32 | – | – | – | 19 | 23 | 30 | – | – | 65 | 11 | 17 | – | 21 | 25 | 33 | 0.6 | 1 | 75 | 14 | 20 | – | 28 | 32 | 0.6 | 1.1 | – | – | – | – |
| 07 | 35 | – | – | – | 21 | 25 | 33 | – | – | 72 | 12 | 17 | – | 23 | 27 | 37 | 0.6 | 1.1 | 80 | 14 | 21 | – | 31 | 34.9 | 0.6 | 1.5 | 100 | 25 | 43 | 1.5 |
| 08 | 40 | – | – | – | 22 | 26 | 35 | – | – | 80 | 13 | 18 | – | 23 | 30.2 | 40 | 0.6 | 1.1 | 90 | 16 | 23 | – | 33 | 36.5 | 1 | 1.5 | 110 | 27 | 46 | 2 |
| 09 | 45 | – | – | – | 22 | 26 | 35 | – | – | 85 | 13 | 19 | – | 23 | 30.2 | 40 | 0.6 | 1.1 | 100 | 17 | 25 | – | 36 | 39.7 | 1 | 1.5 | 120 | 29 | 50 | 2 |
| 10 | 50 | – | – | – | 22 | 26 | 35 | – | – | 90 | 13 | 20 | – | 23 | 30.2 | 40 | 0.6 | 1.1 | 110 | 19 | 27 | – | 40 | 44.4 | 1 | 2 | 130 | 31 | 53 | 2.1 |
| 11 | 55 | – | – | – | 24 | 30 | 40 | – | – | 100 | 14 | 21 | – | 25 | 33.3 | 45 | 0.6 | 1.5 | 120 | 21 | 29 | – | 43 | 49.2 | 1.1 | 2 | 140 | 33 | 57 | 2.1 |
| 12 | 60 | – | – | – | 24 | 30 | 40 | – | – | 110 | 16 | 22 | – | 28 | 36.5 | 50 | 1 | 1.5 | 130 | 22 | 31 | – | 46 | 54 | 1.1 | 2.1 | 150 | 35 | 60 | 2.1 |
| 13 | 65 | – | – | – | 27 | 34 | 45 | – | – | 120 | 18 | 23 | – | 31 | 38.1 | 56 | 1 | 1.5 | 140 | 24 | 33 | – | 48 | 58.7 | 1.1 | 2.1 | 160 | 37 | 64 | 2.1 |
| 14 | 70 | – | – | – | 27 | 34 | 45 | – | – | 125 | 18 | 24 | – | 31 | 39.7 | 56 | 1 | 1.5 | 150 | 25 | 35 | – | 51 | 63.5 | 1.5 | 2.1 | 180 | 42 | 74 | 3 |
| 15 | 75 | – | – | – | 30 | 37 | 50 | – | – | 130 | 18 | 25 | – | 31 | 41.3 | 56 | 1 | 1.5 | 160 | 27 | 37 | – | 55 | 68.3 | 1.5 | 2.1 | 190 | 45 | 77 | 3 |
| 16 | 80 | – | – | – | 30 | 37 | 50 | – | – | 140 | 19 | 26 | – | 33 | 44.4 | 60 | 1 | 2 | 170 | 28 | 39 | – | 58 | 68.3 | 1.5 | 2.1 | 200 | 48 | 80 | 3 |
| 17 | 85 | – | – | – | 31 | 41 | 56 | – | – | 150 | 21 | 28 | – | 36 | 49.2 | 65 | 1.1 | 2 | 180 | 30 | 41 | – | 60 | 73 | 2 | 3 | 210 | 52 | 86 | 4 |
| 18 | 90 | 150 | – | – | 33 | 45 | 60 | – | 2 | 160 | 22 | 30 | – | 40 | 52.4 | 69 | 1.1 | 2 | 190 | 30 | 43 | – | 64 | 73 | 2 | 3 | 225 | 54 | 90 | 4 |
| 19 | 95 | 160 | – | – | 39 | 52 | 65 | – | 2 | 170 | 24 | 32 | – | 43 | 55.6 | 75 | 1.1 | 2.1 | 200 | 33 | 45 | – | 67 | 77.8 | 2 | 3 | 240 | 55 | 95 | 4 |
| 20 | 100 | 165 | 21 | 30 | 39 | 52 | 65 | 1.1 | 2 | 180 | 25 | 34 | – | 46 | 60.3 | 80 | 1.5 | 2.1 | 215 | 36 | 47 | 51 | 73 | 82.6 | 2.1 | 3 | 250 | 58 | 98 | 4 |

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **21** | **105** | **175** | 22 | 33 | 42 | 56 | 69 | 1.1 | 2 | **190** | 27 | 36 | | 50 | 65.1 | 85 | 1.5 | 2.1 | **225** | 37 | 49 | 53 | 77 | 87.3 | 2.1 | 3 | **260** | 60 | 100 | 4 |
| **22** | **110** | **180** | 22 | 33 | 42 | 56 | 69 | 1.1 | 2 | **200** | 28 | 38 | | 53 | 69.8 | 90 | 1.5 | 2.1 | **240** | 42 | 50 | 57 | 80 | 92.1 | 3 | 3 | **280** | 65 | 108 | 4 |
| **24** | **120** | **200** | 25 | 38 | 48 | 62 | 80 | 1.5 | 2 | **215** | – | 40 | 42 | 58 | 76 | 95 | – | 2.1 | **260** | 44 | 55 | 62 | 86 | 106 | 3 | 3 | **310** | 72 | 118 | 5 |
| **26** | **130** | **210** | 25 | 38 | 48 | 64 | 80 | 1.5 | 2 | **230** | – | 40 | 46 | 64 | 80 | 100 | – | 3 | **280** | 48 | 58 | 66 | 93 | 112 | 3 | 4 | **340** | 78 | 128 | 5 |
| **28** | **140** | **225** | 27 | 40 | 50 | 68 | 85 | 1.5 | 2.1 | **250** | – | 42 | 50 | 68 | 88 | 109 | – | 3 | **300** | 50 | 62 | 70 | 102 | 118 | 4 | 4 | **360** | 82 | 132 | 5 |
| **30** | **150** | **250** | 31 | 46 | 60 | 80 | 100 | 2 | 2.1 | **270** | – | 45 | 54 | 73 | 96 | 118 | – | 3 | **320** | – | 65 | 75 | 108 | 128 | – | 4 | **380** | 85 | 138 | 5 |
| **32** | **160** | **270** | 34 | 51 | 66 | 86 | 109 | 2 | 2.1 | **290** | – | 48 | 58 | 80 | 104 | 128 | – | 3 | **340** | – | 68 | 79 | 114 | 136 | – | 4 | **400** | 88 | 142 | 5 |
| **34** | **170** | **280** | 34 | 51 | 66 | 88 | 109 | 2 | 2.1 | **310** | – | 52 | 62 | 86 | 110 | 140 | – | 4 | **360** | – | 72 | 84 | 120 | 140 | – | 4 | **420** | 92 | 145 | 5 |
| **36** | **180** | **300** | 37 | 56 | 72 | 96 | 118 | 2.1 | 3 | **320** | – | 52 | 62 | 86 | 112 | 140 | – | 4 | **380** | – | 75 | 88 | 126 | 150 | – | 4 | **440** | 95 | 150 | 6 |
| **38** | **190** | **320** | 42 | 60 | 78 | 104 | 128 | 3 | 3 | **340** | – | 55 | 65 | 92 | 120 | 150 | – | 4 | **400** | – | 78 | 92 | 132 | 155 | – | 5 | **460** | 98 | 155 | 6 |
| **40** | **200** | **340** | 44 | 65 | 82 | 112 | 140 | 3 | 3 | **360** | – | 58 | 70 | 98 | 128 | 160 | – | 4 | **420** | – | 80 | 97 | 138 | 165 | – | 5 | **480** | 102 | 160 | 6 |
| **44** | **220** | **370** | 48 | 69 | 88 | 120 | 150 | 3 | 4 | **400** | – | 65 | 78 | 108 | 144 | 180 | – | 4 | **460** | – | 88 | 106 | 145 | 180 | – | 5 | **540** | 115 | 180 | 6 |
| **48** | **240** | **400** | 50 | 74 | 95 | 128 | 160 | 4 | 4 | **440** | – | 72 | 85 | 120 | 160 | 200 | – | 4 | **500** | – | 95 | 114 | 155 | 195 | – | 5 | **580** | 122 | 190 | 6 |
| **52** | **260** | **440** | 57 | 82 | 106 | 144 | 180 | 4 | 4 | **480** | – | 80 | 90 | 130 | 174 | 218 | – | 5 | **540** | – | 102 | 123 | 165 | 206 | – | 6 | **620** | 132 | 206 | 7.5 |
| **56** | **280** | **460** | 57 | 82 | 106 | 146 | 180 | 4 | 5 | **500** | – | 80 | 90 | 130 | 176 | 218 | – | 5 | **580** | – | 108 | 132 | 175 | 224 | – | 6 | **670** | 140 | 224 | 7.5 |
| **60** | **300** | **500** | 63 | 90 | 118 | 160 | 200 | 5 | 5 | **540** | – | 85 | 98 | 140 | 192 | 243 | – | 5 | **620** | – | 109 | 140 | 185 | 236 | – | 7.5 | **710** | 150 | 236 | 7.5 |
| **64** | **320** | **540** | 71 | 100 | 128 | 176 | 218 | 5 | 5 | **580** | – | 92 | 105 | 150 | 208 | 258 | – | 5 | **670** | – | 112 | 155 | 200 | 258 | – | 7.5 | **750** | 155 | 250 | 9.5 |
| **68** | **340** | **580** | 78 | 106 | 140 | 190 | 243 | 5 | 5 | **620** | – | 92 | 118 | 165 | 224 | 280 | – | 6 | **710** | – | 118 | 165 | 212 | 272 | – | 7.5 | **800** | 165 | 265 | 9.5 |
| **72** | **360** | **600** | 78 | 106 | 140 | 192 | 243 | 5 | 5 | **650** | – | 95 | 122 | 170 | 232 | 290 | – | 6 | **750** | – | 125 | 170 | 224 | 290 | – | 7.5 | **850** | 180 | 280 | 9.5 |
| **76** | **380** | **620** | 78 | 106 | 140 | 194 | 243 | 5 | 5 | **680** | – | 95 | 132 | 175 | 240 | 300 | – | 6 | **780** | – | 128 | 175 | 230 | 300 | – | 7.5 | **900** | 190 | 300 | 9.5 |
| **80** | **400** | **650** | 80 | 112 | 145 | 200 | 250 | 6 | 6 | **720** | – | 103 | 140 | 185 | 256 | 315 | – | 6 | **820** | – | 136 | 185 | 243 | 308 | – | 7.5 | **950** | 200 | 315 | 12 |
| **84** | **420** | **700** | 88 | 122 | 165 | 224 | 280 | 6 | 6 | **760** | – | 109 | 150 | 195 | 272 | 335 | – | 7.5 | **850** | – | 136 | 190 | 250 | 315 | – | 9.5 | **980** | 206 | 325 | 12 |
| **88** | **440** | **720** | 88 | 122 | 165 | 226 | 280 | 6 | 6 | **790** | – | 112 | 155 | 200 | 280 | 345 | – | 7.5 | **900** | – | 145 | 200 | 265 | 345 | – | 9.5 | **1030** | 212 | 335 | 12 |
| **92** | **460** | **760** | 95 | 132 | 175 | 240 | 300 | 6 | 7.5 | **830** | – | 118 | 165 | 212 | 296 | 365 | – | 7.5 | **950** | – | 155 | 212 | 280 | 365 | – | 9.5 | **1060** | 218 | 345 | 12 |
| **96** | **480** | **790** | 100 | 136 | 180 | 248 | 308 | 6 | 7.5 | **870** | – | 125 | 170 | 224 | 310 | 388 | – | 7.5 | **980** | – | 160 | 218 | 290 | 375 | – | 9.5 | **1120** | 230 | 365 | 15 |
| **/500** | **500** | **830** | 106 | 145 | 190 | 264 | 325 | 7.5 | 7.5 | **920** | – | 136 | 185 | 243 | 336 | 412 | – | 7.5 | **1030** | – | 170 | 230 | 300 | 388 | – | 12 | **1150** | 236 | 375 | 15 |
| **/530** | **530** | **870** | 109 | 150 | 195 | 272 | 335 | 7.5 | 7.5 | **980** | – | 145 | 200 | 258 | 355 | 450 | – | 9.5 | **1090** | – | 180 | 243 | 325 | 412 | – | 12 | **1220** | 250 | 400 | 15 |
| **/560** | **560** | **920** | 115 | 160 | 206 | 280 | 355 | 7.5 | 7.5 | **1030** | – | 150 | 206 | 272 | 365 | 475 | – | 9.5 | **1150** | – | 190 | 258 | 335 | 438 | – | 12 | **1280** | 258 | 412 | 15 |
| **/600** | **600** | **980** | 122 | 170 | 218 | 300 | 375 | 7.5 | 7.5 | **1090** | – | 155 | 212 | 280 | 388 | 488 | – | 9.5 | **1220** | – | 200 | 272 | 355 | 462 | – | 15 | **1360** | 272 | 438 | 15 |
| **/630** | **630** | **1030** | 128 | 175 | 230 | 315 | 400 | 7.5 | 7.5 | **1150** | – | 165 | 230 | 300 | 412 | 515 | – | 12 | **1280** | – | 206 | 280 | 375 | 488 | – | 15 | **1420** | 280 | 450 | 15 |
| **/670** | **670** | **1090** | 136 | 185 | 243 | 336 | 412 | 7.5 | 7.5 | **1220** | – | 175 | 243 | 315 | 438 | 545 | – | 12 | **1360** | – | 218 | 300 | 400 | 515 | – | 15 | **1500** | 290 | 475 | 15 |
| **/710** | **710** | **1150** | 140 | 195 | 250 | 345 | 438 | 9.5 | 9.5 | **1280** | – | 180 | 250 | 325 | 450 | 560 | – | 12 | **1420** | – | 224 | 308 | 412 | 530 | – | 15 | – | – | – | – |
| **/750** | **750** | **1220** | 150 | 206 | 272 | 365 | 475 | 9.5 | 9.5 | **1360** | – | 195 | 265 | 345 | 475 | 615 | – | 15 | **1500** | – | 236 | 325 | 438 | 560 | – | 15 | – | – | – | – |
| **/800** | **800** | **1280** | 155 | 212 | 272 | 375 | 475 | 9.5 | 9.5 | **1420** | – | 200 | 272 | 355 | 488 | 615 | – | 15 | **1600** | – | 258 | 355 | 462 | 600 | – | 15 | – | – | – | – |
| **/850** | **850** | **1360** | 165 | 224 | 290 | 400 | 500 | 12 | 12 | **1500** | – | 206 | 280 | 375 | 515 | 650 | – | 15 | **1700** | – | 272 | 375 | 488 | 630 | – | 19 | – | – | – | – |
| **/900** | **900** | **1420** | 165 | 230 | 300 | 412 | 515 | 12 | 12 | **1580** | – | 218 | 300 | 388 | 515 | 670 | – | 15 | **1780** | – | 280 | 388 | 500 | 650 | – | 19 | – | – | – | – |
| **/950** | **950** | **1500** | 175 | 243 | 315 | 438 | 545 | 12 | 12 | **1660** | – | 230 | 315 | 412 | 530 | 710 | – | 15 | **1850** | – | 290 | 400 | 515 | 670 | – | 19 | – | – | – | – |
| **/1000** | **1000** | **1580** | 185 | 258 | 335 | 462 | 580 | 12 | 12 | **1750** | – | 243 | 330 | 425 | 560 | 750 | – | 15 | **1950** | – | 300 | 412 | 545 | 710 | – | 19 | – | – | – | – |
| **/1060** | **1060** | **1660** | 190 | 265 | 345 | 475 | 600 | 12 | 15 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| **/1120** | **1120** | **1750** | – | 280 | 365 | 475 | 630 | – | 15 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| **/1180** | **1180** | **1850** | – | 290 | 388 | 500 | 670 | – | 15 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| **/1250** | **1250** | **1950** | – | 308 | 400 | 530 | 710 | – | 15 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| **/1320** | **1320** | **2060** | – | 325 | 425 | 560 | 750 | – | 15 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| **/1400** | **1400** | **2180** | – | 345 | 450 | 580 | 775 | – | 19 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| **/1500** | **1500** | **2300** | – | 355 | 462 | 600 | 800 | – | 19 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |

Remarks The chamfer dimensions listed in this table do not necessarily apply to the following chamfers: (a) Chamfers of the grooves in outer rings that have snap ring grooves.
(b) For thin section cylindrical roller bearings, the chamfers on side without rib and bearing bore (in case of an inner ring) or outer surface (in case of an outer ring).
(c) For angular contact ball bearings, the chamfers between the front face and bore (in case of an inner ring) or outer surface (in case of an outer ring).
(d) Chamfers on inner rings of bearings with tapered bores.

## Table 6.2 Boundary Dimensions of Tapered Roller Bearings

| Tapered Roller Brgs. | | 329 | | | | | | | | | 320 X | | | | | | | | | 330 | | | | | | | | | 331 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bore Number | d | Diameter Series 9 | | | | | | | | | Diameter Series 0 | | | | | | | | | Diameter Series 0 | | | | | | | | | Diameter Series 1 | | | | | | | | |
| | | D | Dimension Series 29 | | | | | | Chamfer Dimension | | D | Dimension Series 20 | | | Dimension Series 30 | | | Chamfer Dimension | | D | Dimension Series 20 | | | Dimension Series 30 | | | Chamfer Dimension | | D | Dimension Series 31 | | | Chamfer Dimension | | |
| | | | I | | | II | | | Cone | Cup | | | | | | | | Cone | Cup | | | | | | | | Cone | Cup | | | | | Cone | Cup | |
| | | | B | C | T | B | C | T | r (min.) | | | B | C | T | B | C | T | r (min.) | | | B | C | T | B | C | T | r (min.) | | | B | C | T | r (min.) | | |
| 00 | 10 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 01 | 12 | – | – | – | – | – | – | – | – | – | 28 | 11 | – | 11 | 13 | – | 13 | 0.3 | 0.3 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 02 | 15 | – | – | – | – | – | – | – | – | – | 32 | 12 | – | 12 | 14 | – | 14 | 0.3 | 0.3 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 03 | 17 | – | – | – | – | – | – | – | – | – | 35 | 13 | – | 13 | 15 | – | 15 | 0.3 | 0.3 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 04 | 20 | 37 | 11 | – | 11.6 | 12 | 9 | 12 | 0.3 | 0.3 | 42 | 15 | 12 | 15 | 17 | – | 17 | 0.6 | 0.6 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| /22 | 22 | 40 | | – | | 12 | 9 | 12 | 0.3 | 0.3 | 44 | 15 | 11.5 | 15 | – | – | – | 0.6 | 0.6 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 05 | 25 | 42 | 11 | – | 11.6 | 12 | 9 | 12 | 0.3 | 0.3 | 47 | 15 | 11.5 | 15 | 17 | 14 | 17 | 0.6 | 0.6 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| /28 | 28 | 45 | | – | | 12 | 9 | 12 | 0.3 | 0.3 | 52 | 16 | 12 | 16 | – | – | – | 1 | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 06 | 30 | 47 | 11 | – | 11.6 | 12 | 9 | 12 | 0.3 | 0.3 | 55 | 17 | 13 | 17 | 20 | 16 | 20 | 1 | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| /32 | 32 | 52 | | – | | 15 | 10 | 14 | 0.6 | 0.6 | 58 | 17 | 13 | 17 | – | – | – | 1 | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 07 | 35 | 55 | 13 | – | 14 | 14 | 11.5 | 14 | 0.6 | 0.6 | 62 | 18 | 14 | 18 | 21 | 17 | 21 | 1 | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 08 | 40 | 62 | 14 | – | 15 | 15 | 12 | 15 | 0.6 | 0.6 | 68 | 19 | 14.5 | 19 | 22 | 18 | 22 | 1 | 1 | 75 | 26 | 20.5 | 26 | 1.5 | 1.5 | 75 | 26 | 20.5 | 26 | 1.5 | 1.5 | 75 | 26 | 20.5 | 26 | 1.5 | 1.5 |
| 09 | 45 | 68 | 14 | – | 15 | 15 | 12 | 15 | 0.6 | 0.6 | 75 | 20 | 15.5 | 20 | 24 | 19 | 24 | 1 | 1 | 80 | 26 | 20.5 | 26 | 1.5 | 1.5 | 80 | 26 | 20.5 | 26 | 1.5 | 1.5 | 80 | 26 | 20.5 | 26 | 1.5 | 1.5 |
| 10 | 50 | 72 | 14 | – | 15 | 15 | 12 | 15 | 0.6 | 0.6 | 80 | 20 | 15.5 | 20 | 24 | 19 | 24 | 1 | 1 | 85 | 26 | 20 | 26 | 1.5 | 1.5 | 85 | 26 | 20 | 26 | 1.5 | 1.5 | 85 | 26 | 20 | 26 | 1.5 | 1.5 |
| 11 | 55 | 80 | 16 | – | 17 | 17 | 14 | 17 | 1 | 1 | 90 | 23 | 17.5 | 23 | 27 | 21 | 27 | 1.5 | 1.5 | 95 | 30 | 23 | 30 | 1.5 | 1.5 | 95 | 30 | 23 | 30 | 1.5 | 1.5 | 95 | 30 | 23 | 30 | 1.5 | 1.5 |
| 12 | 60 | 85 | 16 | – | 17 | 17 | 14 | 17 | 1 | 1 | 95 | 23 | 17.5 | 23 | 27 | 21 | 27 | 1.5 | 1.5 | 100 | 30 | 23 | 30 | 1.5 | 1.5 | 100 | 30 | 23 | 30 | 1.5 | 1.5 | 100 | 30 | 23 | 30 | 1.5 | 1.5 |
| 13 | 65 | 90 | 16 | – | 17 | 17 | 14 | 17 | 1 | 1 | 100 | 23 | 17.5 | 23 | 27 | 21 | 27 | 1.5 | 1.5 | 110 | 34 | 26.5 | 34 | 1.5 | 1.5 | 110 | 34 | 26.5 | 34 | 1.5 | 1.5 | 110 | 34 | 26.5 | 34 | 1.5 | 1.5 |
| 14 | 70 | 100 | 19 | – | 20 | 20 | 16 | 20 | 1 | 1 | 110 | 25 | 19 | 25 | 31 | 25.5 | 31 | 1.5 | 1.5 | 120 | 37 | 29 | 37 | 2 | 1.5 | 120 | 37 | 29 | 37 | 2 | 1.5 | 120 | 37 | 29 | 37 | 2 | 1.5 |
| 15 | 75 | 105 | 19 | – | 20 | 20 | 16 | 20 | 1 | 1 | 115 | 25 | 19 | 25 | 31 | 25.5 | 31 | 1.5 | 1.5 | 125 | 37 | 29 | 37 | 2 | 1.5 | 125 | 37 | 29 | 37 | 2 | 1.5 | 125 | 37 | 29 | 37 | 2 | 1.5 |
| 16 | 80 | 110 | 19 | – | 20 | 20 | 16 | 20 | 1 | 1 | 125 | 29 | 22 | 29 | 36 | 29.5 | 36 | 1.5 | 1.5 | 130 | 37 | 29 | 37 | 2 | 1.5 | 130 | 37 | 29 | 37 | 2 | 1.5 | 130 | 37 | 29 | 37 | 2 | 1.5 |
| 17 | 85 | 120 | 22 | – | 23 | 23 | 18 | 23 | 1.5 | 1.5 | 130 | 29 | 22 | 29 | 36 | 29.5 | 36 | 1.5 | 1.5 | 140 | 41 | 32 | 41 | 2.5 | 2 | 140 | 41 | 32 | 41 | 2.5 | 2 | 140 | 41 | 32 | 41 | 2.5 | 2 |
| 18 | 90 | 125 | 22 | – | 23 | 23 | 18 | 23 | 1.5 | 1.5 | 140 | 32 | 24 | 32 | 39 | 32.5 | 39 | 2 | 1.5 | 150 | 45 | 35 | 45 | 2.5 | 2 | 150 | 45 | 35 | 45 | 2.5 | 2 | 150 | 45 | 35 | 45 | 2.5 | 2 |
| 19 | 95 | 130 | 22 | – | 23 | 23 | 18 | 23 | 1.5 | 1.5 | 145 | 32 | 24 | 32 | 39 | 32.5 | 39 | 2 | 1.5 | 160 | 49 | 38 | 49 | 2.5 | 2 | 160 | 49 | 38 | 49 | 2.5 | 2 | 160 | 49 | 38 | 49 | 2.5 | 2 |
| 20 | 100 | 140 | 24 | – | 25 | 25 | 20 | 25 | 1.5 | 1.5 | 150 | 32 | 24 | 32 | 39 | 32.5 | 39 | 2 | 1.5 | 165 | 52 | 40 | 52 | 2.5 | 2 | 165 | 52 | 40 | 52 | 2.5 | 2 | 165 | 52 | 40 | 52 | 2.5 | 2 |
| 21 | 105 | 145 | 24 | – | 25 | 25 | 20 | 25 | 1.5 | 1.5 | 160 | 35 | 26 | 35 | 43 | 34 | 43 | 2.5 | 2 | 175 | 56 | 44 | 56 | 2.5 | 2 | 175 | 56 | 44 | 56 | 2.5 | 2 | 175 | 56 | 44 | 56 | 2.5 | 2 |
| 22 | 110 | 150 | 24 | – | 25 | 25 | 20 | 25 | 1.5 | 1.5 | 170 | 38 | 29 | 38 | 47 | 37 | 47 | 2.5 | 2 | 180 | 56 | 43 | 56 | 2.5 | 2 | 180 | 56 | 43 | 56 | 2.5 | 2 | 180 | 56 | 43 | 56 | 2.5 | 2 |
| 24 | 120 | 165 | 27 | – | 29 | 29 | 23 | 29 | 1.5 | 1.5 | 180 | 38 | 29 | 38 | 48 | 38 | 48 | 2.5 | 2 | 200 | 62 | 48 | 62 | 2.5 | 2 | 200 | 62 | 48 | 62 | 2.5 | 2 | 200 | 62 | 48 | 62 | 2.5 | 2 |
| 26 | 130 | 180 | 30 | – | 32 | 32 | 25 | 32 | 2 | 1.5 | 200 | 45 | 34 | 45 | 55 | 43 | 55 | 2.5 | 2 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 28 | 140 | 190 | 30 | – | 32 | 32 | 25 | 32 | 2 | 1.5 | 210 | 45 | 34 | 45 | 56 | 44 | 56 | 2.5 | 2 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 30 | 150 | 210 | 36 | – | 38 | 38 | 30 | 38 | 2.5 | 2 | 225 | 48 | 36 | 48 | 59 | 46 | 59 | 3 | 2.5 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 32 | 160 | 220 | 36 | – | 38 | 38 | 30 | 38 | 2.5 | 2 | 240 | 51 | 38 | 51 | – | – | – | 3 | 2.5 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 34 | 170 | 230 | 36 | – | 38 | 38 | 30 | 38 | 2.5 | 2 | 260 | 57 | 43 | 57 | – | – | – | 3 | 2.5 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 36 | 180 | 250 | 42 | – | 45 | 45 | 34 | 45 | 2.5 | 2 | 280 | 64 | 48 | 64 | – | – | – | 3 | 2.5 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 38 | 190 | 260 | 42 | – | 45 | 45 | 34 | 45 | 2.5 | 2 | 290 | 64 | 48 | 64 | – | – | – | 3 | 2.5 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 40 | 200 | 280 | 48 | – | 51 | 51 | 39 | 51 | 3 | 2.5 | 310 | 70 | 53 | 70 | – | – | – | 3 | 2.5 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 44 | 220 | 300 | 48 | – | 51 | 51 | 39 | 51 | 3 | 2.5 | 340 | 76 | 57 | 76 | – | – | – | 4 | 3 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 48 | 240 | 320 | 48 | – | 51 | 51 | 39 | 51 | 3 | 2.5 | 360 | 76 | 57 | 76 | – | – | – | 4 | 3 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 52 | 260 | 360 | – | – | – | 63.5 | 48 | 63.5 | 3 | 2.5 | 400 | 87 | 65 | 87 | – | – | – | 5 | 4 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 56 | 280 | 380 | – | – | – | 63.5 | 48 | 63.5 | 3 | 2.5 | 420 | 87 | 65 | 87 | – | – | – | 5 | 4 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 60 | 300 | 420 | – | – | – | 76 | 57 | 76 | 4 | 3 | 460 | 100 | 74 | 100 | – | – | – | 5 | 4 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 64 | 320 | 440 | – | – | – | 76 | 57 | 76 | 4 | 3 | 480 | 100 | 74 | 100 | – | – | – | 5 | 4 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 68 | 340 | 460 | – | – | – | 76 | 57 | 76 | 4 | 3 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 72 | 360 | 480 | – | – | – | 76 | 57 | 76 | 4 | 3 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |

**Remarks**

1. Other series not conforming to this table are also specified by ISO.
2. In the Dimension Series of Diameter Series 9, Classification I is those specified by the old standard, Classification II is those specified by ISO.
3. The chamfer dimensions listed are the minimum permissible dimensions specified by ISO. They do not apply to chamfers on the front face.

Units: mm

| 302 | | | 322 | | | 332 | | | | | 303 or 303D | | | | | 313 | | | 323 | | | | | Tapered Roller Brgs. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diameter Series 2 | | | | | | | | | | | Diameter Series 3 | | | | | | | | | | | | | | |
| D | Dimension Series 02 | | | Dimension Series 22 | | | Dimension Series 32 | | | Chamfer Dimension | | D | Dimension Series 03 | | | | Dimension Series 13 | | | Dimension Series 23 | | | Chamfer Dimension | | d | Bore Number |
| | | | | | | | | | | Cone | Cup | | | | | | | | | | | | Cone | Cup | | |
| | B | C | T | B | C | T | B | C | T | r (min.) | | | B | C | C (1) | T | B | C | T | B | C | T | r (min.) | | | |
| 30 | 9 | – | 9.7 | 14 | – | 14.7 | – | – | – | 0.6 | 0.6 | 35 | 11 | – | – | 11.9 | – | – | – | 17 | – | 17.9 | 0.6 | 0.6 | 10 | 00 |
| 32 | 10 | 9 | 10.75 | 14 | – | 14.75 | – | – | – | 0.6 | 0.6 | 37 | 12 | – | – | 12.9 | – | – | – | 17 | – | 17.9 | 1 | 1 | 12 | 01 |
| 35 | 11 | 10 | 11.75 | 14 | – | 14.75 | – | – | – | 0.6 | 0.6 | 42 | 13 | 11 | – | 14.25 | – | – | – | 17 | 14 | 18.25 | 1 | 1 | 15 | 02 |
| 40 | 12 | 11 | 13.25 | 16 | 14 | 17.25 | – | – | – | 1 | 1 | 47 | 14 | 12 | – | 15.25 | – | – | – | 19 | 16 | 20.25 | 1 | 1 | 17 | 03 |
| 47 | 14 | 12 | 15.25 | 18 | 15 | 19.25 | – | – | – | 1 | 1 | 52 | 15 | 13 | – | 16.25 | – | – | – | 21 | 18 | 22.25 | 1.5 | 1.5 | 20 | 04 |
| 50 | 14 | 12 | 15.25 | 18 | 15 | 19.25 | – | – | – | 1 | 1 | 56 | 16 | 14 | – | 17.25 | – | – | – | 21 | 18 | 22.25 | 1.5 | 1.5 | 22 | /22 |
| 52 | 15 | 13 | 16.25 | 18 | 15 | 19.25 | 22 | 18 | 22 | 1 | 1 | 62 | 17 | 15 | 13 | 18.25 | – | – | – | 24 | 20 | 25.25 | 1.5 | 1.5 | 25 | 05 |
| 58 | 16 | 14 | 17.25 | 19 | 16 | 20.25 | 24 | 19 | 24 | 1 | 1 | 68 | 18 | 15 | 14 | 19.75 | – | – | – | 24 | 20 | 25.75 | 1.5 | 1.5 | 28 | /28 |
| 62 | 16 | 14 | 17.25 | 20 | 17 | 21.25 | 25 | 19.5 | 25 | 1 | 1 | 72 | 19 | 16 | 14 | 20.75 | – | – | – | 27 | 23 | 28.75 | 1.5 | 1.5 | 30 | 06 |
| 65 | 17 | 15 | 18.25 | 21 | 18 | 22.25 | 26 | 20.5 | 26 | 1 | 1 | 75 | 20 | 17 | 15 | 21.75 | – | – | – | 28 | 24 | 29.75 | 1.5 | 1.5 | 32 | /32 |
| 72 | 17 | 15 | 18.25 | 23 | 19 | 24.25 | 28 | 22 | 28 | 1.5 | 1.5 | 80 | 21 | 18 | 15 | 22.75 | – | – | – | 31 | 25 | 32.75 | 2 | 1.5 | 35 | 07 |
| 80 | 18 | 16 | 19.75 | 23 | 19 | 24.75 | 32 | 25 | 32 | 1.5 | 1.5 | 90 | 23 | 20 | 17 | 25.25 | – | – | – | 33 | 27 | 35.25 | 2 | 1.5 | 40 | 08 |
| 85 | 19 | 16 | 20.75 | 23 | 19 | 24.75 | 32 | 25 | 32 | 1.5 | 1.5 | 100 | 25 | 22 | 18 | 27.25 | – | – | – | 36 | 30 | 38.25 | 2 | 1.5 | 45 | 09 |
| 90 | 20 | 17 | 21.75 | 23 | 19 | 24.75 | 32 | 24.5 | 32 | 1.5 | 1.5 | 110 | 27 | 23 | 19 | 29.25 | – | – | – | 40 | 33 | 42.25 | 2.5 | 2 | 50 | 10 |
| 100 | 21 | 18 | 22.75 | 25 | 21 | 26.75 | 35 | 27 | 35 | 2 | 1.5 | 120 | 29 | 25 | 21 | 31.5 | – | – | – | 43 | 35 | 45.5 | 2.5 | 2 | 55 | 11 |
| 110 | 22 | 19 | 23.75 | 28 | 24 | 29.75 | 38 | 29 | 38 | 2 | 1.5 | 130 | 31 | 26 | 22 | 33.5 | – | – | – | 46 | 37 | 48.5 | 3 | 2.5 | 60 | 12 |
| 120 | 23 | 20 | 24.75 | 31 | 27 | 32.75 | 41 | 32 | 41 | 2 | 1.5 | 140 | 33 | 28 | 23 | 36 | – | – | – | 48 | 39 | 51 | 3 | 2.5 | 65 | 13 |
| 125 | 24 | 21 | 26.25 | 31 | 27 | 33.25 | 41 | 32 | 41 | 2 | 1.5 | 150 | 35 | 30 | 25 | 38 | – | – | – | 51 | 42 | 54 | 3 | 2.5 | 70 | 14 |
| 130 | 25 | 22 | 27.25 | 31 | 27 | 33.25 | 41 | 31 | 41 | 2 | 1.5 | 160 | 37 | 31 | 26 | 40 | – | – | – | 55 | 45 | 58 | 3 | 2.5 | 75 | 15 |
| 140 | 26 | 22 | 28.25 | 33 | 28 | 35.25 | 46 | 35 | 46 | 2.5 | 2 | 170 | 39 | 33 | 27 | 42.5 | – | – | – | 58 | 48 | 61.5 | 3 | 2.5 | 80 | 16 |
| 150 | 28 | 24 | 30.5 | 36 | 30 | 38.5 | 49 | 37 | 49 | 2.5 | 2 | 180 | 41 | 34 | 28 | 44.5 | – | – | – | 60 | 49 | 63.5 | 4 | 3 | 85 | 17 |
| 160 | 30 | 26 | 32.5 | 40 | 34 | 42.5 | 55 | 42 | 55 | 2.5 | 2 | 190 | 43 | 36 | 30 | 46.5 | – | – | – | 64 | 53 | 67.5 | 4 | 3 | 90 | 18 |
| 170 | 32 | 27 | 34.5 | 43 | 37 | 45.5 | 58 | 44 | 58 | 3 | 2.5 | 200 | 45 | 38 | 32 | 49.5 | – | – | – | 67 | 55 | 71.5 | 4 | 3 | 95 | 19 |
| 180 | 34 | 29 | 37 | 46 | 39 | 49 | 63 | 48 | 63 | 3 | 2.5 | 215 | 47 | 39 | – | 51.5 | 51 | 35 | 56.5 | 73 | 60 | 77.5 | 4 | 3 | 100 | 20 |
| 190 | 36 | 30 | 39 | 50 | 43 | 53 | 68 | 52 | 68 | 3 | 2.5 | 225 | 49 | 41 | – | 53.5 | 53 | 36 | 58 | 77 | 63 | 81.5 | 4 | 3 | 105 | 21 |
| 200 | 38 | 32 | 41 | 53 | 46 | 56 | – | – | – | 3 | 2.5 | 240 | 50 | 42 | – | 54.5 | 57 | 38 | 63 | 80 | 65 | 84.5 | 4 | 3 | 110 | 22 |
| 215 | 40 | 34 | 43.5 | 58 | 50 | 61.5 | – | – | – | 3 | 2.5 | 260 | 55 | 46 | – | 59.5 | 62 | 42 | 68 | 86 | 69 | 90.5 | 4 | 3 | 120 | 24 |
| 230 | 40 | 34 | 43.75 | 64 | 54 | 67.75 | – | – | – | 4 | 3 | 280 | 58 | 49 | – | 63.75 | 66 | 44 | 72 | 93 | 78 | 98.75 | 5 | 4 | 130 | 26 |
| 250 | 42 | 36 | 45.75 | 68 | 58 | 71.75 | – | – | – | 4 | 3 | 300 | 62 | 53 | – | 67.75 | 70 | 47 | 77 | 102 | 85 | 107.75 | 5 | 4 | 140 | 28 |
| 270 | 45 | 38 | 49 | 73 | 60 | 77 | – | – | – | 4 | 3 | 320 | 65 | 55 | – | 72 | 75 | 50 | 82 | 108 | 90 | 114 | 5 | 4 | 150 | 30 |
| 290 | 48 | 40 | 52 | 80 | 67 | 84 | – | – | – | 4 | 3 | 340 | 68 | 58 | – | 75 | 79 | – | 87 | 114 | 95 | 121 | 5 | 4 | 160 | 32 |
| 310 | 52 | 43 | 57 | 86 | 71 | 91 | – | – | – | 5 | 4 | 360 | 72 | 62 | – | 80 | 84 | – | 92 | 120 | 100 | 127 | 5 | 4 | 170 | 34 |
| 320 | 52 | 43 | 57 | 86 | 71 | 91 | – | – | – | 5 | 4 | 380 | 75 | 64 | – | 83 | 88 | – | 97 | 126 | 106 | 134 | 5 | 4 | 180 | 36 |
| 340 | 55 | 46 | 60 | 92 | 75 | 97 | – | – | – | 5 | 4 | 400 | 78 | 65 | – | 86 | 92 | – | 101 | 132 | 109 | 140 | 6 | 5 | 190 | 38 |
| 360 | 58 | 48 | 64 | 98 | 82 | 104 | – | – | – | 5 | 4 | 420 | 80 | 67 | – | 89 | 97 | – | 107 | 138 | 115 | 146 | 6 | 5 | 200 | 40 |
| 400 | 65 | 54 | 72 | 108 | 90 | 114 | – | – | – | 5 | 4 | 460 | 88 | 73 | – | 97 | 106 | – | 117 | 145 | 122 | 154 | 6 | 5 | 220 | 44 |
| 440 | 72 | 60 | 79 | 120 | 100 | 127 | – | – | – | 5 | 4 | 500 | 95 | 80 | – | 105 | 114 | – | 125 | 155 | 132 | 165 | 6 | 5 | 240 | 48 |
| 480 | 80 | 67 | 89 | 130 | 106 | 137 | – | – | – | 6 | 5 | 540 | 102 | 85 | – | 113 | 123 | – | 135 | 165 | 136 | 176 | 6 | 6 | 260 | 52 |
| 500 | 80 | 67 | 89 | 130 | 106 | 137 | – | – | – | 6 | 5 | 580 | 108 | 90 | – | 119 | 132 | – | 145 | 175 | 145 | 187 | 6 | 6 | 280 | 56 |
| 540 | 85 | 71 | 96 | 140 | 115 | 149 | – | – | – | 6 | 5 | – | – | – | – | – | – | – | – | – | – | – | – | – | 300 | 60 |
| 580 | 92 | 75 | 104 | 150 | 125 | 159 | – | – | – | 6 | 5 | – | – | – | – | – | – | – | – | – | – | – | – | – | 320 | 64 |
| – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 340 | 68 |
| – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 360 | 72 |

Note (1) Regarding steep-slope bearing 303D, in DIN, the one corresponding to 303D of JIS is numbered 313. For bearings with bore diameters larger than 100 mm, those of dimension series 13 are numbered 313.

## Table 6.3 Boundary Dimensions of Thrust Bearings (Flat Seats) —1—

| Thrust Ball Brgs. | | | | | | | | | 511 | | | | | 512 | 522 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Spherical Thrust Roller Brgs. | | | | | | | | | | | | | 292 | | | | |

| Bore Number | d | Diameter Series 0 | | | | | Diameter Series 1 | | | | | Diameter Series 2 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | D | Dimension Series 70 T | 90 T | 10 T | r (min.) | D | Dimension Series 71 T | 91 T | 11 T | r (min.) | D | Dimension Series 72 T | 92 T | 12 T | 22 T | 22 Central Washer $d_2$ | 22 Central Washer B | r (min.) | $r_1$ (min.) |
| 4 | 4 | 12 | 4 | – | 6 | 0.3 | – | – | – | – | – | 16 | 6 | – | 8 | – | – | – | 0.3 | – |
| 6 | 6 | 16 | 5 | – | 7 | 0.3 | – | – | – | – | – | 20 | 6 | – | 9 | – | – | – | 0.3 | – |
| 8 | 8 | 18 | 5 | – | 7 | 0.3 | – | – | – | – | – | 22 | 6 | – | 9 | – | – | – | 0.3 | – |
| 00 | 10 | 20 | 5 | – | 7 | 0.3 | 24 | 6 | – | 9 | 0.3 | 26 | 7 | – | 11 | – | – | – | 0.6 | – |
| 01 | 12 | 22 | 5 | – | 7 | 0.3 | 26 | 6 | – | 9 | 0.3 | 28 | 7 | – | 11 | – | – | – | 0.6 | – |
| 02 | 15 | 26 | 5 | – | 7 | 0.3 | 28 | 6 | – | 9 | 0.3 | 32 | 8 | – | 12 | 22 | 10 | 5 | 0.6 | 0.3 |
| 03 | 17 | 28 | 5 | – | 7 | 0.3 | 30 | 6 | – | 9 | 0.3 | 35 | 8 | – | 12 | – | – | – | 0.6 | – |
| 04 | 20 | 32 | 6 | – | 8 | 0.3 | 35 | 7 | – | 10 | 0.3 | 40 | 9 | – | 14 | 26 | 15 | 6 | 0.6 | 0.3 |
| 05 | 25 | 37 | 6 | – | 8 | 0.3 | 42 | 8 | – | 11 | 0.6 | 47 | 10 | – | 15 | 28 | 20 | 7 | 0.6 | 0.3 |
| 06 | 30 | 42 | 6 | – | 8 | 0.3 | 47 | 8 | – | 11 | 0.6 | 52 | 10 | – | 16 | 29 | 25 | 7 | 0.6 | 0.3 |
| 07 | 35 | 47 | 6 | – | 8 | 0.3 | 52 | 8 | – | 12 | 0.6 | 62 | 12 | – | 18 | 34 | 30 | 8 | 1 | 0.3 |
| 08 | 40 | 52 | 6 | – | 9 | 0.3 | 60 | 9 | – | 13 | 0.6 | 68 | 13 | – | 19 | 36 | 30 | 9 | 1 | 0.6 |
| 09 | 45 | 60 | 7 | – | 10 | 0.3 | 65 | 9 | – | 14 | 0.6 | 73 | 13 | – | 20 | 37 | 35 | 9 | 1 | 0.6 |
| 10 | 50 | 65 | 7 | – | 10 | 0.3 | 70 | 9 | – | 14 | 0.6 | 78 | 13 | – | 22 | 39 | 40 | 9 | 1 | 0.6 |
| 11 | 55 | 70 | 7 | – | 10 | 0.3 | 78 | 10 | – | 16 | 0.6 | 90 | 16 | 21 | 25 | 45 | 45 | 10 | 1 | 0.6 |
| 12 | 60 | 75 | 7 | – | 10 | 0.3 | 85 | 11 | – | 17 | 1 | 95 | 16 | 21 | 26 | 46 | 50 | 10 | 1 | 0.6 |
| 13 | 65 | 80 | 7 | – | 10 | 0.3 | 90 | 11 | – | 18 | 1 | 100 | 16 | 21 | 27 | 47 | 55 | 10 | 1 | 0.6 |
| 14 | 70 | 85 | 7 | – | 10 | 0.3 | 95 | 11 | – | 18 | 1 | 105 | 16 | 21 | 27 | 47 | 55 | 10 | 1 | 1 |
| 15 | 75 | 90 | 7 | – | 10 | 0.3 | 100 | 11 | – | 19 | 1 | 110 | 16 | 21 | 27 | 47 | 60 | 10 | 1 | 1 |
| 16 | 80 | 95 | 7 | – | 10 | 0.3 | 105 | 11 | – | 19 | 1 | 115 | 16 | 21 | 28 | 48 | 65 | 10 | 1 | 1 |
| 17 | 85 | 100 | 7 | – | 10 | 0.3 | 110 | 11 | – | 19 | 1 | 125 | 18 | 24 | 31 | 55 | 70 | 12 | 1 | 1 |
| 18 | 90 | 105 | 7 | – | 10 | 0.3 | 120 | 14 | – | 22 | 1 | 135 | 20 | 27 | 35 | 62 | 75 | 14 | 1.1 | 1 |
| 20 | 100 | 120 | 9 | – | 14 | 0.6 | 135 | 16 | 21 | 25 | 1 | 150 | 23 | 30 | 38 | 67 | 85 | 15 | 1.1 | 1 |
| 22 | 110 | 130 | 9 | – | 14 | 0.6 | 145 | 16 | 21 | 25 | 1 | 160 | 23 | 30 | 38 | 67 | 95 | 15 | 1.1 | 1 |
| 24 | 120 | 140 | 9 | – | 14 | 0.6 | 155 | 16 | 21 | 25 | 1 | 170 | 23 | 30 | 39 | 68 | 100 | 15 | 1.1 | 1.1 |
| 26 | 130 | 150 | 9 | – | 14 | 0.6 | 170 | 18 | 24 | 30 | 1 | 190 | 27 | 36 | 45 | 80 | 110 | 18 | 1.5 | 1.1 |
| 28 | 140 | 160 | 9 | – | 14 | 0.6 | 180 | 18 | 24 | 31 | 1 | 200 | 27 | 36 | 46 | 81 | 120 | 18 | 1.5 | 1.1 |
| 30 | 150 | 170 | 9 | – | 14 | 0.6 | 190 | 18 | 24 | 31 | 1 | 215 | 29 | 39 | 50 | 89 | 130 | 20 | 1.5 | 1.1 |
| 32 | 160 | 180 | 9 | – | 14 | 0.6 | 200 | 18 | 24 | 31 | 1 | 225 | 29 | 39 | 51 | 90 | 140 | 20 | 1.5 | 1.1 |
| 34 | 170 | 190 | 9 | – | 14 | 0.6 | 215 | 20 | 27 | 34 | 1.1 | 240 | 32 | 42 | 55 | 97 | 150 | 21 | 1.5 | 1.1 |
| 36 | 180 | 200 | 9 | – | 14 | 0.6 | 225 | 20 | 27 | 34 | 1.1 | 250 | 32 | 42 | 56 | 98 | 150 | 21 | 1.5 | 2 |
| 38 | 190 | 215 | 11 | – | 17 | 1 | 240 | 23 | 30 | 37 | 1.1 | 270 | 36 | 48 | 62 | 109 | 160 | 24 | 2 | 2 |
| 40 | 200 | 225 | 11 | – | 17 | 1 | 250 | 23 | 30 | 37 | 1.1 | 280 | 36 | 48 | 62 | 109 | 170 | 24 | 2 | 2 |
| 44 | 220 | 250 | 14 | – | 22 | 1 | 270 | 23 | 30 | 37 | 1.1 | 300 | 36 | 48 | 63 | 110 | 190 | 24 | 2 | 2 |
| 48 | 240 | 270 | 14 | – | 22 | 1 | 300 | 27 | 36 | 45 | 1.5 | 340 | 45 | 60 | 78 | – | – | – | 2.1 | – |
| 52 | 260 | 290 | 14 | – | 22 | 1 | 320 | 27 | 36 | 45 | 1.5 | 360 | 45 | 60 | 79 | – | – | – | 2.1 | – |
| 56 | 280 | 310 | 14 | – | 22 | 1 | 350 | 32 | 42 | 53 | 1.5 | 380 | 45 | 60 | 80 | – | – | – | 2.1 | – |
| 60 | 300 | 340 | 18 | 24 | 30 | 1 | 380 | 36 | 48 | 62 | 2 | 420 | 54 | 73 | 95 | – | – | – | 3 | – |
| 64 | 320 | 360 | 18 | 24 | 30 | 1 | 400 | 36 | 48 | 63 | 2 | 440 | 54 | 73 | 95 | – | – | – | 3 | – |

**Remarks** 1. Dimension Series 22, 23, and 24 are double direction bearings.
2. The maximum permissible outside diameter of shaft and central washers and minimum permissible bore diameter of housing washers are omitted here. (Refer to the bearings tables for Thrust Bearings).

Units: mm

| | | | 513 | 523 | | | | | | 514 | 524 | | | | | Thrust Ball Brgs. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 293 | | | | | | | 294 | | | | | | | Spherical Thrust Roller Brgs. |

| Diameter Series 3 | | | | | | | | | Diameter Series 4 | | | | | | | | | | Diameter Series 5 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D | Dimension Series | | | | | r (min.) | $r_1$ (min.) | | D | Dimension Series | | | | | r (min.) | $r_1$ (min.) | | | D | Dimension Series | r (min.) | d | Bore Number |
| | 73 | 93 | 13 | 23 | 23 | | | | | 74 | 94 | 14 | 24 | 24 | | | | | | 95 | | | |
| | T | | | | Central Washer | | | | | T | | | | Central Washer | | | | | | T | | | |
| | | | | | $d_2$ | B | | | | | | | | $d_2$ | B | | | | | | | | |
| **20** | 7 | – | 11 | – | – | – | 0.6 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | **4** | **4** |
| **24** | 8 | – | 12 | – | – | – | 0.6 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | **6** | **6** |
| **26** | 8 | – | 12 | – | – | – | 0.6 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | **8** | **8** |
| **30** | 9 | – | 14 | – | – | – | 0.6 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | **10** | **00** |
| **32** | 9 | – | 14 | – | – | – | 0.6 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | **12** | **01** |
| **37** | 10 | – | 15 | – | – | – | 0.6 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | **15** | **02** |
| **40** | 10 | – | 16 | – | – | – | 0.6 | – | – | – | – | – | – | – | – | – | – | – | **52** | 21 | 1 | **17** | **03** |
| **47** | 12 | – | 18 | – | – | – | 1 | – | – | – | – | – | – | – | – | – | – | – | **60** | 24 | 1 | **20** | **04** |
| **52** | 12 | – | 18 | 34 | 20 | 8 | 1 | 0.3 | **60** | 16 | 21 | 24 | 45 | 15 | 11 | 1 | 0.6 | **73** | 29 | 1.1 | **25** | **05** |
| **60** | 14 | – | 21 | 38 | 25 | 9 | 1 | 0.3 | **70** | 18 | 24 | 28 | 52 | 20 | 12 | 1 | 0.6 | **85** | 34 | 1.1 | **30** | **06** |
| **68** | 15 | – | 24 | 44 | 30 | 10 | 1 | 0.3 | **80** | 20 | 27 | 32 | 59 | 25 | 14 | 1.1 | 0.6 | **100** | 39 | 1.1 | **35** | **07** |
| **78** | 17 | 22 | 26 | 49 | 30 | 12 | 1 | 0.6 | **90** | 23 | 30 | 36 | 65 | 30 | 15 | 1.1 | 0.6 | **110** | 42 | 1.5 | **40** | **08** |
| **85** | 18 | 24 | 28 | 52 | 35 | 12 | 1 | 0.6 | **100** | 25 | 34 | 39 | 72 | 35 | 17 | 1.1 | 0.6 | **120** | 45 | 2 | **45** | **09** |
| **95** | 20 | 27 | 31 | 58 | 40 | 14 | 1.1 | 0.6 | **110** | 27 | 36 | 43 | 78 | 40 | 18 | 1.5 | 0.6 | **135** | 51 | 2 | **50** | **10** |
| **105** | 23 | 30 | 35 | 64 | 45 | 15 | 1.1 | 0.6 | **120** | 29 | 39 | 48 | 87 | 45 | 20 | 1.5 | 0.6 | **150** | 58 | 2.1 | **55** | **11** |
| **110** | 23 | 30 | 35 | 64 | 50 | 15 | 1.1 | 0.6 | **130** | 32 | 42 | 51 | 93 | 50 | 21 | 1.5 | 0.6 | **160** | 60 | 2.1 | **60** | **12** |
| **115** | 23 | 30 | 36 | 65 | 55 | 15 | 1.1 | 0.6 | **140** | 34 | 45 | 56 | 101 | 50 | 23 | 2 | 1 | **170** | 63 | 2.1 | **65** | **13** |
| **125** | 25 | 34 | 40 | 72 | 55 | 16 | 1.1 | 1 | **150** | 36 | 48 | 60 | 107 | 55 | 24 | 2 | 1 | **180** | 67 | 3 | **70** | **14** |
| **135** | 27 | 36 | 44 | 79 | 60 | 18 | 1.5 | 1 | **160** | 38 | 51 | 65 | 115 | 60 | 26 | 2 | 1 | **190** | 69 | 3 | **75** | **15** |
| **140** | 27 | 36 | 44 | 79 | 65 | 18 | 1.5 | 1 | **170** | 41 | 54 | 68 | 120 | 65 | 27 | 2.1 | 1 | **200** | 73 | 3 | **80** | **16** |
| **150** | 29 | 39 | 49 | 87 | 70 | 19 | 1.5 | 1 | **180** | 42 | 58 | 72 | 128 | 65 | 29 | 2.1 | 1.1 | **215** | 78 | 4 | **85** | **17** |
| **155** | 29 | 39 | 50 | 88 | 75 | 19 | 1.5 | 1 | **190** | 45 | 60 | 77 | 135 | 70 | 30 | 2.1 | 1.1 | **225** | 82 | 4 | **90** | **18** |
| **170** | 32 | 42 | 55 | 97 | 85 | 21 | 1.5 | 1 | **210** | 50 | 67 | 85 | 150 | 80 | 33 | 3 | 1.1 | **250** | 90 | 4 | **100** | **20** |
| **190** | 36 | 48 | 63 | 110 | 95 | 24 | 2 | 1 | **230** | 54 | 73 | 95 | 166 | 90 | 37 | 3 | 1.1 | **270** | 95 | 5 | **110** | **22** |
| **210** | 41 | 54 | 70 | 123 | 100 | 27 | 2.1 | 1.1 | **250** | 58 | 78 | 102 | 177 | 95 | 40 | 4 | 1.5 | **300** | 109 | 5 | **120** | **24** |
| **225** | 42 | 58 | 75 | 130 | 110 | 30 | 2.1 | 1.1 | **270** | 63 | 85 | 110 | 192 | 100 | 42 | 4 | 2 | **320** | 115 | 5 | **130** | **26** |
| **240** | 45 | 60 | 80 | 140 | 120 | 31 | 2.1 | 1.1 | **280** | 63 | 85 | 112 | 196 | 110 | 44 | 4 | 2 | **340** | 122 | 5 | **140** | **28** |
| **250** | 45 | 60 | 80 | 140 | 130 | 31 | 2.1 | 1.1 | **300** | 67 | 90 | 120 | 209 | 120 | 46 | 4 | 2 | **360** | 125 | 6 | **150** | **30** |
| **270** | 50 | 67 | 87 | 153 | 140 | 33 | 3 | 1.1 | **320** | 73 | 95 | 130 | 226 | 130 | 50 | 5 | 2 | **380** | 132 | 6 | **160** | **32** |
| **280** | 50 | 67 | 87 | 153 | 150 | 33 | 3 | 1.1 | **340** | 78 | 103 | 135 | 236 | 135 | 50 | 5 | 2.1 | **400** | 140 | 6 | **170** | **34** |
| **300** | 54 | 73 | 95 | 165 | 150 | 37 | 3 | 2 | **360** | 82 | 109 | 140 | 245 | 140 | 52 | 5 | 3 | **420** | 145 | 6 | **180** | **36** |
| **320** | 58 | 78 | 105 | 183 | 160 | 40 | 4 | 2 | **380** | 85 | 115 | 150 | – | – | – | 5 | – | **440** | 150 | 6 | **190** | **38** |
| **340** | 63 | 85 | 110 | 192 | 170 | 42 | 4 | 2 | **400** | 90 | 122 | 155 | – | – | – | 5 | – | **460** | 155 | 7.5 | **200** | **40** |
| **360** | 63 | 85 | 112 | – | – | – | 4 | – | **420** | 90 | 122 | 160 | – | – | – | 6 | – | **500** | 170 | 7.5 | **220** | **44** |
| **380** | 63 | 85 | 112 | – | – | – | 4 | – | **440** | 90 | 122 | 160 | – | – | – | 6 | – | **540** | 180 | 7.5 | **240** | **48** |
| **420** | 73 | 95 | 130 | – | – | – | 5 | – | **480** | 100 | 132 | 175 | – | – | – | 6 | – | **580** | 190 | 9.5 | **260** | **52** |
| **440** | 73 | 95 | 130 | – | – | – | 5 | – | **520** | 109 | 145 | 190 | – | – | – | 6 | – | **620** | 206 | 9.5 | **280** | **56** |
| **480** | 82 | 109 | 140 | – | – | – | 5 | – | **540** | 109 | 145 | 190 | – | – | – | 6 | – | **670** | 224 | 9.5 | **300** | **60** |
| **500** | 82 | 109 | 140 | – | – | – | 5 | – | **580** | 118 | 155 | 205 | – | – | – | 7.5 | – | **710** | 236 | 9.5 | **320** | **64** |

## Table 6.3 Boundary Dimensions of Thrust Bearings (Flat Seats) — 2 —

| Thrust Ball Brgs. | | | | | | | | | 511 | | | | | 512 | 522 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Spherical Thrust Roller Brgs. | | | | | | | | | | | | | 292 | | | | | | | |
| Bore Number | d | Diameter Series 0 | | | | | Diameter Series 1 | | | | | Diameter Series 2 | | | | | | | | |
| | | D | Dimension Series 70 T | 90 T | 10 T | r (min.) | D | Dimension Series 71 T | 91 T | 11 T | r (min.) | D | Dimension Series 72 T | 92 T | 12 T | 22 T | 22 T Central Washer $d_2$ | 22 T Central Washer B | r (min.) | $r_1$ (min.) |
| 68 | 340 | 380 | 18 | 24 | 30 | 1 | 420 | 36 | 48 | 64 | 2 | 460 | 54 | 73 | 96 | – | – | – | 3 | – |
| 72 | 360 | 400 | 18 | 24 | 30 | 1 | 440 | 36 | 48 | 65 | 2 | 500 | 63 | 85 | 110 | – | – | – | 4 | – |
| 76 | 380 | 420 | 18 | 24 | 30 | 1 | 460 | 36 | 48 | 65 | 2 | 520 | 63 | 85 | 112 | – | – | – | 4 | – |
| 80 | 400 | 440 | 18 | 24 | 30 | 1 | 480 | 36 | 48 | 65 | 2 | 540 | 63 | 85 | 112 | – | – | – | 4 | – |
| 84 | 420 | 460 | 18 | 24 | 30 | 1 | 500 | 36 | 48 | 65 | 2 | 580 | 73 | 95 | 130 | – | – | – | 5 | – |
| 88 | 440 | 480 | 18 | 24 | 30 | 1 | 540 | 45 | 60 | 80 | 2.1 | 600 | 73 | 95 | 130 | – | – | – | 5 | – |
| 92 | 460 | 500 | 18 | 24 | 30 | 1 | 560 | 45 | 60 | 80 | 2.1 | 620 | 73 | 95 | 130 | – | – | – | 5 | – |
| 96 | 480 | 520 | 18 | 24 | 30 | 1 | 580 | 45 | 60 | 80 | 2.1 | 650 | 78 | 103 | 135 | – | – | – | 5 | – |
| /500 | 500 | 540 | 18 | 24 | 30 | 1 | 600 | 45 | 60 | 80 | 2.1 | 670 | 78 | 103 | 135 | – | – | – | 5 | – |
| /530 | 530 | 580 | 23 | 30 | 38 | 1.1 | 640 | 50 | 67 | 85 | 3 | 710 | 82 | 109 | 140 | – | – | – | 5 | – |
| /560 | 560 | 610 | 23 | 30 | 38 | 1.1 | 670 | 50 | 67 | 85 | 3 | 750 | 85 | 115 | 150 | – | – | – | 5 | – |
| /600 | 600 | 650 | 23 | 30 | 38 | 1.1 | 710 | 50 | 67 | 85 | 3 | 800 | 90 | 122 | 160 | – | – | – | 5 | – |
| /630 | 630 | 680 | 23 | 30 | 38 | 1.1 | 750 | 54 | 73 | 95 | 3 | 850 | 100 | 132 | 175 | – | – | – | 6 | – |
| /670 | 670 | 730 | 27 | 36 | 45 | 1.5 | 800 | 58 | 78 | 105 | 4 | 900 | 103 | 140 | 180 | – | – | – | 6 | – |
| /710 | 710 | 780 | 32 | 42 | 53 | 1.5 | 850 | 63 | 85 | 112 | 4 | 950 | 109 | 145 | 190 | – | – | – | 6 | – |
| /750 | 750 | 820 | 32 | 42 | 53 | 1.5 | 900 | 67 | 90 | 120 | 4 | 1000 | 112 | 150 | 195 | – | – | – | 6 | – |
| /800 | 800 | 870 | 32 | 42 | 53 | 1.5 | 950 | 67 | 90 | 120 | 4 | 1060 | 118 | 155 | 205 | – | – | – | 7.5 | – |
| /850 | 850 | 920 | 32 | 42 | 53 | 1.5 | 1000 | 67 | 90 | 120 | 4 | 1120 | 122 | 160 | 212 | – | – | – | 7.5 | – |
| /900 | 900 | 980 | 36 | 48 | 63 | 2 | 1060 | 73 | 95 | 130 | 5 | 1180 | 125 | 170 | 220 | – | – | – | 7.5 | – |
| /950 | 950 | 1030 | 36 | 48 | 63 | 2 | 1120 | 78 | 103 | 135 | 5 | 1250 | 136 | 180 | 236 | – | – | – | 7.5 | – |
| /1000 | 1000 | 1090 | 41 | 54 | 70 | 2.1 | 1180 | 82 | 109 | 140 | 5 | 1320 | 145 | 190 | 250 | – | – | – | 9.5 | – |
| /1060 | 1060 | 1150 | 41 | 54 | 70 | 2.1 | 1250 | 85 | 115 | 150 | 5 | 1400 | 155 | 206 | 265 | – | – | – | 9.5 | – |
| /1120 | 1120 | 1220 | 45 | 60 | 80 | 2.1 | 1320 | 90 | 122 | 160 | 5 | 1460 | – | 206 | – | – | – | – | 9.5 | – |
| /1180 | 1180 | 1280 | 45 | 60 | 80 | 2.1 | 1400 | 100 | 132 | 175 | 6 | 1520 | – | 206 | – | – | – | – | 9.5 | – |
| /1250 | 1250 | 1360 | 50 | 67 | 85 | 3 | 1460 | – | – | 175 | 6 | 1610 | – | 216 | – | – | – | – | 9.5 | – |
| /1320 | 1320 | 1440 | – | – | 95 | 3 | 1540 | – | – | 175 | 6 | 1700 | – | 228 | – | – | – | – | 9.5 | – |
| /1400 | 1400 | 1520 | – | – | 95 | 3 | 1630 | – | – | 180 | 6 | 1790 | – | 234 | – | – | – | – | 12 | – |
| /1500 | 1500 | 1630 | – | – | 105 | 4 | 1750 | – | – | 195 | 6 | 1920 | – | 252 | – | – | – | – | 12 | – |
| /1600 | 1600 | 1730 | – | – | 105 | 4 | 1850 | – | – | 195 | 6 | 2040 | – | 264 | – | – | – | – | 15 | – |
| /1700 | 1700 | 1840 | – | – | 112 | 4 | 1970 | – | – | 212 | 7.5 | 2160 | – | 276 | – | – | – | – | 15 | – |
| /1800 | 1800 | 1950 | – | – | 120 | 4 | 2080 | – | – | 220 | 7.5 | 2280 | – | 288 | – | – | – | – | 15 | – |
| /1900 | 1900 | 2060 | – | – | 130 | 5 | 2180 | – | – | 220 | 7.5 | – | – | – | – | – | – | – | – | – |
| /2000 | 2000 | 2160 | – | – | 130 | 5 | 2300 | – | – | 236 | 7.5 | – | – | – | – | – | – | – | – | – |
| /2120 | 2120 | 2300 | – | – | 140 | 5 | 2430 | – | – | 243 | 7.5 | – | – | – | – | – | – | – | – | – |
| /2240 | 2240 | 2430 | – | – | 150 | 5 | 2570 | – | – | 258 | 9.5 | – | – | – | – | – | – | – | – | – |
| /2360 | 2360 | 2550 | – | – | 150 | 5 | 2700 | – | – | 265 | 9.5 | – | – | – | – | – | – | – | – | – |
| /2500 | 2500 | 2700 | – | – | 160 | 5 | 2850 | – | – | 272 | 9.5 | – | – | – | – | – | – | – | – | – |

**Remarks** 1. Dimension Series 22, 23, and 24 are double direction bearings.
2. The maximum permissible outside diameter of shaft and central washers and minimum permissible bore diameter of housing washers are omitted here. (Refer to the bearings tables for Thrust Bearings).

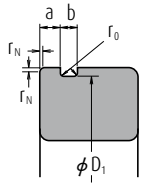
Units: mm

| | | | 513 | 523 | | | | | | 514 | 524 | | | | | Thrust Ball Brgs. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 293 | | | | | | | 294 | | | | | | | Spherical Thrust Roller Brgs. |

| Diameter Series 3 | | | | | | | | | Diameter Series 4 | | | | | | | | | Diameter Series 5 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D | Dimension Series | | | | | r (min.) | $r_1$ (min.) | D | Dimension Series | | | | | r (min.) | $r_1$ (min.) | D | Dimension Series | r (min.) | d | Bore Number |
| | 73 | 93 | 13 | 23 | 23 | | | | 74 | 94 | 14 | 24 | 24 | | | | 95 | | | |
| | T | | | | Central Washer | | | | T | | | | Central Washer | | | | T | | | |
| | | | | | $d_2$ B | | | | | | | | $d_2$ B | | | | | | | |
| **540** | 90 | 122 | 160 | – | – – | 5 | – | **620** | 125 | 170 | 220 | – | – – | 7.5 | – | **750** | 243 | 12 | **340** | **68** |
| **560** | 90 | 122 | 160 | – | – – | 5 | – | **640** | 125 | 170 | 220 | – | – – | 7.5 | – | **780** | 250 | 12 | **360** | **72** |
| **600** | 100 | 132 | 175 | – | – – | 6 | – | **670** | 132 | 175 | 224 | – | – – | 7.5 | – | **820** | 265 | 12 | **380** | **76** |
| **620** | 100 | 132 | 175 | – | – – | 6 | – | **710** | 140 | 185 | 243 | – | – – | 7.5 | – | **850** | 272 | 12 | **400** | **80** |
| **650** | 103 | 140 | 180 | – | – – | 6 | – | **730** | 140 | 185 | 243 | – | – – | 7.5 | – | **900** | 290 | 15 | **420** | **84** |
| **680** | 109 | 145 | 190 | – | – – | 6 | – | **780** | 155 | 206 | 265 | – | – – | 9.5 | – | **950** | 308 | 15 | **440** | **88** |
| **710** | 112 | 150 | 195 | – | – – | 6 | – | **800** | 155 | 206 | 265 | – | – – | 9.5 | – | **980** | 315 | 15 | **460** | **92** |
| **730** | 112 | 150 | 195 | – | – – | 6 | – | **850** | 165 | 224 | 290 | – | – – | 9.5 | – | **1000** | 315 | 15 | **480** | **96** |
| **750** | 112 | 150 | 195 | – | – – | 6 | – | **870** | 165 | 224 | 290 | – | – – | 9.5 | – | **1060** | 335 | 15 | **500** | **/500** |
| **800** | 122 | 160 | 212 | – | – – | 7.5 | – | **920** | 175 | 236 | 308 | – | – – | 9.5 | – | **1090** | 335 | 15 | **530** | **/530** |
| **850** | 132 | 175 | 224 | – | – – | 7.5 | – | **980** | 190 | 250 | 335 | – | – – | 12 | – | **1150** | 355 | 15 | **560** | **/560** |
| **900** | 136 | 180 | 236 | – | – – | 7.5 | – | **1030** | 195 | 258 | 335 | – | – – | 12 | – | **1220** | 375 | 15 | **600** | **/600** |
| **950** | 145 | 190 | 250 | – | – – | 9.5 | – | **1090** | 206 | 280 | 365 | – | – – | 12 | – | **1280** | 388 | 15 | **630** | **/630** |
| **1000** | 150 | 200 | 258 | – | – – | 9.5 | – | **1150** | 218 | 290 | 375 | – | – – | 15 | – | **1320** | 388 | 15 | **670** | **/670** |
| **1060** | 160 | 212 | 272 | – | – – | 9.5 | – | **1220** | 230 | 308 | 400 | – | – – | 15 | – | **1400** | 412 | 15 | **710** | **/710** |
| **1120** | 165 | 224 | 290 | – | – – | 9.5 | – | **1280** | 236 | 315 | 412 | – | – – | 15 | – | – | – | – | **750** | **/750** |
| **1180** | 170 | 230 | 300 | – | – – | 9.5 | – | **1360** | 250 | 335 | 438 | – | – – | 15 | – | – | – | – | **800** | **/800** |
| **1250** | 180 | 243 | 315 | – | – – | 12 | – | **1440** | – | 354 | – | – | – – | 15 | – | – | – | – | **850** | **/850** |
| **1320** | 190 | 250 | 335 | – | – – | 12 | – | **1520** | – | 372 | – | – | – – | 15 | – | – | – | – | **900** | **/900** |
| **1400** | 200 | 272 | 355 | – | – – | 12 | – | **1600** | – | 390 | – | – | – – | 15 | – | – | – | – | **950** | **/950** |
| **1460** | – | 276 | – | – | – – | 12 | – | **1670** | – | 402 | – | – | – – | 15 | – | – | – | – | **1000** | **/1000** |
| **1540** | – | 288 | – | – | – – | 15 | – | **1770** | – | 426 | – | – | – – | 15 | – | – | – | – | **1060** | **/1060** |
| **1630** | – | 306 | – | – | – – | 15 | – | **1860** | – | 444 | – | – | – – | 15 | – | – | – | – | **1120** | **/1120** |
| **1710** | – | 318 | – | – | – – | 15 | – | **1950** | – | 462 | – | – | – – | 19 | – | – | – | – | **1180** | **/1180** |
| **1800** | – | 330 | – | – | – – | 19 | – | **2050** | – | 480 | – | – | – – | 19 | – | – | – | – | **1250** | **/1250** |
| **1900** | – | 348 | – | – | – – | 19 | – | **2160** | – | 505 | – | – | – – | 19 | – | – | – | – | **1320** | **/1320** |
| **2000** | – | 360 | – | – | – – | 19 | – | **2280** | – | 530 | – | – | – – | 19 | – | – | – | – | **1400** | **/1400** |
| **2140** | – | 384 | – | – | – – | 19 | – | – | – | – | – | – | – – | – | – | – | – | – | **1500** | **/1500** |
| **2270** | – | 402 | – | – | – – | 19 | – | – | – | – | – | – | – – | – | – | – | – | – | **1600** | **/1600** |
| – | – | – | – | – | – – | – | – | – | – | – | – | – | – – | – | – | – | – | – | **1700** | **/1700** |
| – | – | – | – | – | – – | – | – | – | – | – | – | – | – – | – | – | – | – | – | **1800** | **/1800** |
| – | – | – | – | – | – – | – | – | – | – | – | – | – | – – | – | – | – | – | – | **1900** | **/1900** |
| – | – | – | – | – | – – | – | – | – | – | – | – | – | – – | – | – | – | – | – | **2000** | **/2000** |
| – | – | – | – | – | – – | – | – | – | – | – | – | – | – – | – | – | – | – | – | **2120** | **/2120** |
| – | – | – | – | – | – – | – | – | – | – | – | – | – | – – | – | – | – | – | – | **2240** | **/2240** |
| – | – | – | – | – | – – | – | – | – | – | – | – | – | – – | – | – | – | – | – | **2360** | **/2360** |
| – | – | – | – | – | – – | – | – | – | – | – | – | – | – – | – | – | – | – | – | **2500** | **/2500** |

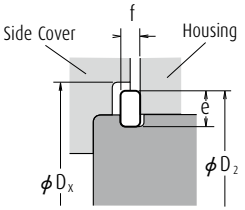
6

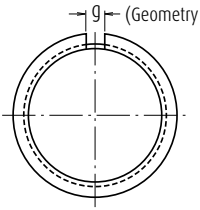
## Table 6.4 Dimensions of Snap Ring Grooves and Locating Snap Rings – (1) Bearings of Dimension Series 18 and 19




| Applicable Bearings | | | Snap Ring Groove | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| d | | D | Snap Ring Groove Diameter $D_1$ | | Snap Ring Groove Position a | | | | Snap Ring Groove Width b | | Radius of Bottom Corners $r_0$ |
| | | | | | Bearing Dimension Series | | | | | | |
| Dimension Series | | | | | 18 | | 19 | | | | |
| 18 | 19 | | max. | min. | max. | min. | max. | min. | max. | min. | max. |
| – | 10 | **22** | 20.8 | 20.5 | – | – | 1.05 | 0.9 | 1.05 | 0.8 | 0.2 |
| – | 12 | **24** | 22.8 | 22.5 | – | – | 1.05 | 0.9 | 1.05 | 0.8 | 0.2 |
| – | 15 | **28** | 26.7 | 26.4 | – | – | 1.3 | 1.15 | 1.2 | 0.95 | 0.25 |
| – | 17 | **30** | 28.7 | 28.4 | – | – | 1.3 | 1.15 | 1.2 | 0.95 | 0.25 |
| 20 | – | **32** | 30.7 | 30.4 | 1.3 | 1.15 | – | – | 1.2 | 0.95 | 0.25 |
| 22 | – | **34** | 32.7 | 32.4 | 1.3 | 1.15 | – | – | 1.2 | 0.95 | 0.25 |
| 25 | 20 | **37** | 35.7 | 35.4 | 1.3 | 1.15 | 1.7 | 1.55 | 1.2 | 0.95 | 0.25 |
| – | 22 | **39** | 37.7 | 37.4 | – | – | 1.7 | 1.55 | 1.2 | 0.95 | 0.25 |
| 28 | – | **40** | 38.7 | 38.4 | 1.3 | 1.15 | – | – | 1.2 | 0.95 | 0.25 |
| 30 | 25 | **42** | 40.7 | 40.4 | 1.3 | 1.15 | 1.7 | 1.55 | 1.2 | 0.95 | 0.25 |
| 32 | – | **44** | 42.7 | 42.4 | 1.3 | 1.15 | – | – | 1.2 | 0.95 | 0.25 |
| – | 28 | **45** | 43.7 | 43.4 | – | – | 1.7 | 1.55 | 1.2 | 0.95 | 0.25 |
| 35 | 30 | **47** | 45.7 | 45.4 | 1.3 | 1.15 | 1.7 | 1.55 | 1.2 | 0.95 | 0.25 |
| 40 | 32 | **52** | 50.7 | 50.4 | 1.3 | 1.15 | 1.7 | 1.55 | 1.2 | 0.95 | 0.25 |
| – | 35 | **55** | 53.7 | 53.4 | – | – | 1.7 | 1.55 | 1.2 | 0.95 | 0.25 |
| 45 | – | **58** | 56.7 | 56.4 | 1.3 | 1.15 | – | – | 1.2 | 0.95 | 0.25 |
| – | 40 | **62** | 60.7 | 60.3 | – | – | 1.7 | 1.55 | 1.2 | 0.95 | 0.25 |
| 50 | – | **65** | 63.7 | 63.3 | 1.3 | 1.15 | – | – | 1.2 | 0.95 | 0.25 |
| – | 45 | **68** | 66.7 | 66.3 | – | – | 1.7 | 1.55 | 1.2 | 0.95 | 0.25 |
| 55 | 50 | **72** | 70.7 | 70.3 | 1.7 | 1.55 | 1.7 | 1.55 | 1.2 | 0.95 | 0.25 |
| 60 | – | **78** | 76.2 | 75.8 | 1.7 | 1.55 | – | – | 1.6 | 1.3 | 0.4 |
| – | 55 | **80** | 77.9 | 77.5 | – | – | 2.1 | 1.9 | 1.6 | 1.3 | 0.4 |
| 65 | 60 | **85** | 82.9 | 82.5 | 1.7 | 1.55 | 2.1 | 1.9 | 1.6 | 1.3 | 0.4 |
| 70 | 65 | **90** | 87.9 | 87.5 | 1.7 | 1.55 | 2.1 | 1.9 | 1.6 | 1.3 | 0.4 |
| 75 | – | **95** | 92.9 | 92.5 | 1.7 | 1.55 | – | – | 1.6 | 1.3 | 0.4 |
| 80 | 70 | **100** | 97.9 | 97.5 | 1.7 | 1.55 | 2.5 | 2.3 | 1.6 | 1.3 | 0.4 |
| – | 75 | **105** | 102.6 | 102.1 | – | – | 2.5 | 2.3 | 1.6 | 1.3 | 0.4 |
| 85 | 80 | **110** | 107.6 | 107.1 | 2.1 | 1.9 | 2.5 | 2.3 | 1.6 | 1.3 | 0.4 |
| 90 | – | **115** | 112.6 | 112.1 | 2.1 | 1.9 | – | – | 1.6 | 1.3 | 0.4 |
| 95 | 85 | **120** | 117.6 | 117.1 | 2.1 | 1.9 | 3.3 | 3.1 | 1.6 | 1.3 | 0.4 |
| 100 | 90 | **125** | 122.6 | 122.1 | 2.1 | 1.9 | 3.3 | 3.1 | 1.6 | 1.3 | 0.4 |
| 105 | 95 | **130** | 127.6 | 127.1 | 2.1 | 1.9 | 3.3 | 3.1 | 1.6 | 1.3 | 0.4 |
| 110 | 100 | **140** | 137.6 | 137.1 | 2.5 | 2.3 | 3.3 | 3.1 | 2.2 | 1.9 | 0.6 |
| – | 105 | **145** | 142.6 | 142.1 | – | – | 3.3 | 3.1 | 2.2 | 1.9 | 0.6 |
| 120 | 110 | **150** | 147.6 | 147.1 | 2.5 | 2.3 | 3.3 | 3.1 | 2.2 | 1.9 | 0.6 |
| 130 | 120 | **165** | 161.8 | 161.3 | 3.3 | 3.1 | 3.7 | 3.5 | 2.2 | 1.9 | 0.6 |
| 140 | – | **175** | 171.8 | 171.3 | 3.3 | 3.1 | – | – | 2.2 | 1.9 | 0.6 |
| – | 130 | **180** | 176.8 | 176.3 | – | – | 3.7 | 3.5 | 2.2 | 1.9 | 0.6 |
| 150 | 140 | **190** | 186.8 | 186.3 | 3.3 | 3.1 | 3.7 | 3.5 | 2.2 | 1.9 | 0.6 |
| 160 | – | **200** | 196.8 | 196.3 | 3.3 | 3.1 | – | – | 2.2 | 1.9 | 0.6 |

**Remarks** The minimum permissible chamfer dimensions $r_N$ on the snap-ring-groove side of the outer rings are as follows:
Dimension series 18 : For outside diameters of 78 mm and less, use 0.3 mm chamfer.
For all others exceeding 78 mm, use 0.5 mm chamfer.
Dimension series 19 : For outside diameters of 24 mm and less, use 0.2 mm chamfer.
For 47 mm and less, use 0.3 mm chamfer.
For all others exceeding 47mm, use 0.5mm chamfer (However, for an outside diameter of 68 mm, use a 0.3 mm chamfer, which is not compliant with ISO 15).

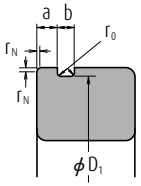



Units: mm

| Locating Snap Ring | | | | | | | Side Cover |
|---|---|---|---|---|---|---|---|
| Locating Snap Ring Number | Cross Sectional Height | | Thickness | | Geometry of snap ring fitted in groove (Reference) | | Stepped Bore Diameter (Reference) |
| | | | | | Slit Width | Snap Ring Outside Diameter | |
| | e | | f | | g | $D_2$ | $D_X$ |
| | max. | min. | max. | min. | approx. | max. | min. |
| **NR 1022** | 2.0 | 1.85 | 0.7 | 0.6 | 2 | 24.8 | 25.5 |
| **NR 1024** | 2.0 | 1.85 | 0.7 | 0.6 | 2 | 26.8 | 27.5 |
| **NR 1028** | 2.05 | 1.9 | 0.85 | 0.75 | 3 | 30.8 | 31.5 |
| **NR 1030** | 2.05 | 1.9 | 0.85 | 0.75 | 3 | 32.8 | 33.5 |
| **NR 1032** | 2.05 | 1.9 | 0.85 | 0.75 | 3 | 34.8 | 35.5 |
| **NR 1034** | 2.05 | 1.9 | 0.85 | 0.75 | 3 | 36.8 | 37.5 |
| **NR 1037** | 2.05 | 1.9 | 0.85 | 0.75 | 3 | 39.8 | 40.5 |
| **NR 1039** | 2.05 | 1.9 | 0.85 | 0.75 | 3 | 41.8 | 42.5 |
| **NR 1040** | 2.05 | 1.9 | 0.85 | 0.75 | 3 | 42.8 | 43.5 |
| **NR 1042** | 2.05 | 1.9 | 0.85 | 0.75 | 3 | 44.8 | 45.5 |
| **NR 1044** | 2.05 | 1.9 | 0.85 | 0.75 | 4 | 46.8 | 47.5 |
| **NR 1045** | 2.05 | 1.9 | 0.85 | 0.75 | 4 | 47.8 | 48.5 |
| **NR 1047** | 2.05 | 1.9 | 0.85 | 0.75 | 4 | 49.8 | 50.5 |
| **NR 1052** | 2.05 | 1.9 | 0.85 | 0.75 | 4 | 54.8 | 55.5 |
| **NR 1055** | 2.05 | 1.9 | 0.85 | 0.75 | 4 | 57.8 | 58.5 |
| **NR 1058** | 2.05 | 1.9 | 0.85 | 0.75 | 4 | 60.8 | 61.5 |
| **NR 1062** | 2.05 | 1.9 | 0.85 | 0.75 | 4 | 64.8 | 65.5 |
| **NR 1065** | 2.05 | 1.9 | 0.85 | 0.75 | 4 | 67.8 | 68.5 |
| **NR 1068** | 2.05 | 1.9 | 0.85 | 0.75 | 5 | 70.8 | 72 |
| **NR 1072** | 2.05 | 1.9 | 0.85 | 0.75 | 5 | 74.8 | 76 |
| **NR 1078** | 3.25 | 3.1 | 1.12 | 1.02 | 5 | 82.7 | 84 |
| **NR 1080** | 3.25 | 3.1 | 1.12 | 1.02 | 5 | 84.4 | 86 |
| **NR 1085** | 3.25 | 3.1 | 1.12 | 1.02 | 5 | 89.4 | 91 |
| **NR 1090** | 3.25 | 3.1 | 1.12 | 1.02 | 5 | 94.4 | 96 |
| **NR 1095** | 3.25 | 3.1 | 1.12 | 1.02 | 5 | 99.4 | 101 |
| **NR 1100** | 3.25 | 3.1 | 1.12 | 1.02 | 5 | 104.4 | 106 |
| **NR 1105** | 4.04 | 3.89 | 1.12 | 1.02 | 5 | 110.7 | 112 |
| **NR 1110** | 4.04 | 3.89 | 1.12 | 1.02 | 5 | 115.7 | 117 |
| **NR 1115** | 4.04 | 3.89 | 1.12 | 1.02 | 5 | 120.7 | 122 |
| **NR 1120** | 4.04 | 3.89 | 1.12 | 1.02 | 7 | 125.7 | 127 |
| **NR 1125** | 4.04 | 3.89 | 1.12 | 1.02 | 7 | 130.7 | 132 |
| **NR 1130** | 4.04 | 3.89 | 1.12 | 1.02 | 7 | 135.7 | 137 |
| **NR 1140** | 4.04 | 3.89 | 1.7 | 1.6 | 7 | 145.7 | 147 |
| **NR 1145** | 4.04 | 3.89 | 1.7 | 1.6 | 7 | 150.7 | 152 |
| **NR 1150** | 4.04 | 3.89 | 1.7 | 1.6 | 7 | 155.7 | 157 |
| **NR 1165** | 4.85 | 4.7 | 1.7 | 1.6 | 7 | 171.5 | 173 |
| **NR 1175** | 4.85 | 4.7 | 1.7 | 1.6 | 10 | 181.5 | 183 |
| **NR 1180** | 4.85 | 4.7 | 1.7 | 1.6 | 10 | 186.5 | 188 |
| **NR 1190** | 4.85 | 4.7 | 1.7 | 1.6 | 10 | 196.5 | 198 |
| **NR 1200** | 4.85 | 4.7 | 1.7 | 1.6 | 10 | 206.5 | 208 |

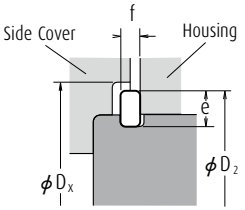
## Table 6.4 Dimensions of Snap Ring Grooves and Locating Snap Rings – (2)
## Bearing of Diameter Series 0, 2, 3, and 4

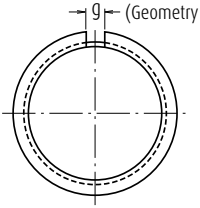



| Applicable Bearings | | | | | Snap Ring Groove | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d | | | | D | Snap Ring Groove Diameter $D_1$ | | Snap Ring Groove Position a | | | | Snap Ring Groove Width b | | Radius of Bottom Corners $r_0$ |
| | | | | | | | Bearing Diameter Series | | | | | | |
| Diameter Series | | | | | | | 0 | | 2, 3, 4 | | | | |
| 0 | 2 | 3 | 4 | | max. | min. | max. | min. | max. | min. | max. | min. | max. |
| 10 | – | – | – | **26** | 24.5 | 24.25 | 1.35 | 1.19 | – | – | 1.17 | 0.87 | 0.2 |
| 12 | – | – | – | **28** | 26.5 | 26.25 | 1.35 | 1.19 | – | – | 1.17 | 0.87 | 0.2 |
| – | 10 | 9 | 8 | **30** | 28.17 | 27.91 | – | – | 2.06 | 1.9 | 1.65 | 1.35 | 0.4 |
| 15 | 12 | – | 9 | **32** | 30.15 | 29.9 | 2.06 | 1.9 | 2.06 | 1.9 | 1.65 | 1.35 | 0.4 |
| 17 | 15 | 10 | – | **35** | 33.17 | 32.92 | 2.06 | 1.9 | 2.06 | 1.9 | 1.65 | 1.35 | 0.4 |
| – | – | 12 | 10 | **37** | 34.77 | 34.52 | – | – | 2.06 | 1.9 | 1.65 | 1.35 | 0.4 |
| – | 17 | – | – | **40** | 38.1 | 37.85 | – | – | 2.06 | 1.9 | 1.65 | 1.35 | 0.4 |
| 20 | – | 15 | 12 | **42** | 39.75 | 39.5 | 2.06 | 1.9 | 2.06 | 1.9 | 1.65 | 1.35 | 0.4 |
| 22 | – | – | – | **44** | 41.75 | 41.5 | 2.06 | 1.9 | – | – | 1.65 | 1.35 | 0.4 |
| 25 | 20 | 17 | – | **47** | 44.6 | 44.35 | 2.06 | 1.9 | 2.46 | 2.31 | 1.65 | 1.35 | 0.4 |
| – | 22 | – | – | **50** | 47.6 | 47.35 | – | – | 2.46 | 2.31 | 1.65 | 1.35 | 0.4 |
| 28 | 25 | 20 | 15 | **52** | 49.73 | 49.48 | 2.06 | 1.9 | 2.46 | 2.31 | 1.65 | 1.35 | 0.4 |
| 30 | – | – | – | **55** | 52.6 | 52.35 | 2.08 | 1.88 | – | – | 1.65 | 1.35 | 0.4 |
| – | – | 22 | – | **56** | 53.6 | 53.35 | – | – | 2.46 | 2.31 | 1.65 | 1.35 | 0.4 |
| 32 | 28 | – | – | **58** | 55.6 | 55.35 | 2.08 | 1.88 | 2.46 | 2.31 | 1.65 | 1.35 | 0.4 |
| 35 | 30 | 25 | 17 | **62** | 59.61 | 59.11 | 2.08 | 1.88 | 3.28 | 3.07 | 2.2 | 1.9 | 0.6 |
| – | 32 | – | – | **65** | 62.6 | 62.1 | – | – | 3.28 | 3.07 | 2.2 | 1.9 | 0.6 |
| 40 | – | 28 | – | **68** | 64.82 | 64.31 | 2.49 | 2.29 | 3.28 | 3.07 | 2.2 | 1.9 | 0.6 |
| – | 35 | 30 | 20 | **72** | 68.81 | 68.3 | – | – | 3.28 | 3.07 | 2.2 | 1.9 | 0.6 |
| 45 | – | 32 | – | **75** | 71.83 | 71.32 | 2.49 | 2.29 | 3.28 | 3.07 | 2.2 | 1.9 | 0.6 |
| 50 | 40 | 35 | 25 | **80** | 76.81 | 76.3 | 2.49 | 2.29 | 3.28 | 3.07 | 2.2 | 1.9 | 0.6 |
| – | 45 | – | – | **85** | 81.81 | 81.31 | – | – | 3.28 | 3.07 | 2.2 | 1.9 | 0.6 |
| 55 | 50 | 40 | 30 | **90** | 86.79 | 86.28 | 2.87 | 2.67 | 3.28 | 3.07 | 3 | 2.7 | 0.6 |
| 60 | – | – | – | **95** | 91.82 | 91.31 | 2.87 | 2.67 | – | – | 3 | 2.7 | 0.6 |
| 65 | 55 | 45 | 35 | **100** | 96.8 | 96.29 | 2.87 | 2.67 | 3.28 | 3.07 | 3 | 2.7 | 0.6 |
| 70 | 60 | 50 | 40 | **110** | 106.81 | 106.3 | 2.87 | 2.67 | 3.28 | 3.07 | 3 | 2.7 | 0.6 |
| 75 | – | – | – | **115** | 111.81 | 111.3 | 2.87 | 2.67 | – | – | 3 | 2.7 | 0.6 |
| – | 65 | 55 | 45 | **120** | 115.21 | 114.71 | – | – | 4.06 | 3.86 | 3.4 | 3.1 | 0.6 |
| 80 | 70 | – | – | **125** | 120.22 | 119.71 | 2.87 | 2.67 | 4.06 | 3.86 | 3.4 | 3.1 | 0.6 |
| 85 | 75 | 60 | 50 | **130** | 125.22 | 124.71 | 2.87 | 2.67 | 4.06 | 3.86 | 3.4 | 3.1 | 0.6 |
| 90 | 80 | 65 | 55 | **140** | 135.23 | 134.72 | 3.71 | 3.45 | 4.9 | 4.65 | 3.4 | 3.1 | 0.6 |
| 95 | – | – | – | **145** | 140.23 | 139.73 | 3.71 | 3.45 | – | – | 3.4 | 3.1 | 0.6 |
| 100 | 85 | 70 | 60 | **150** | 145.24 | 144.73 | 3.71 | 3.45 | 4.9 | 4.65 | 3.4 | 3.1 | 0.6 |
| 105 | 90 | 75 | 65 | **160** | 155.22 | 154.71 | 3.71 | 3.45 | 4.9 | 4.65 | 3.4 | 3.1 | 0.6 |
| 110 | 95 | 80 | – | **170** | 163.65 | 163.14 | 3.71 | 3.45 | 5.69 | 5.44 | 3.8 | 3.5 | 0.6 |
| 120 | 100 | 85 | 70 | **180** | 173.66 | 173.15 | 3.71 | 3.45 | 5.69 | 5.44 | 3.8 | 3.5 | 0.6 |
| – | 105 | 90 | 75 | **190** | 183.64 | 183.13 | – | – | 5.69 | 5.44 | 3.8 | 3.5 | 0.6 |
| 130 | 110 | 95 | 80 | **200** | 193.65 | 193.14 | 5.69 | 5.44 | 5.69 | 5.44 | 3.8 | 3.5 | 0.6 |

**Note** (1) The locating snap rings and snap ring grooves of these bearings are not specified by ISO.

**Remarks**
1. The dimensions of these snap ring grooves are not applicable to bearings of dimension series 00, 82, and 83.
2. The minimum permissible chamfer dimension $r_N$ on the snap-ring side of outer rings is 0.5 mm. However, for bearings of diameter series 0 having outside diameters 35 mm and below, it is 0.3 mm.



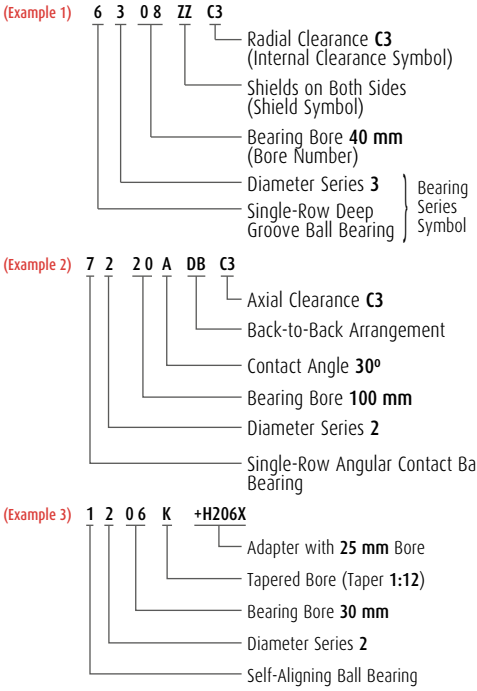

Units: mm

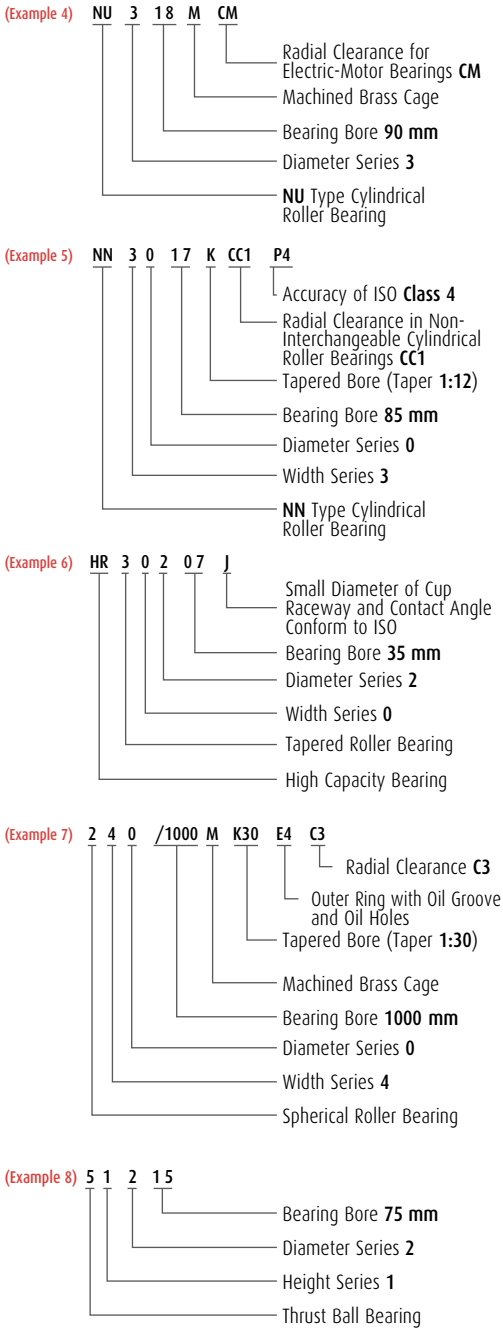
| Locating Snap Ring | | | | | | | Side Cover |
|---|---|---|---|---|---|---|---|
| Locating Snap Ring Number | Cross Sectional Height | | Thickness | | Geometry of snap ring fitted in groove (Reference) | | Stepped Bore Diameter (Reference) |
| | | | | | Slit Width | Snap Ring Outside Diameter | |
| | e | | f | | g | $D_2$ | $D_X$ |
| | max. | min. | max. | min. | approx. | max. | min. |
| **NR 26** (1) | 2.06 | 1.91 | 0.84 | 0.74 | 3 | 28.7 | 29.4 |
| **NR 28** (1) | 2.06 | 1.91 | 0.84 | 0.74 | 3 | 30.7 | 31.4 |
| **NR 30** | 3.25 | 3.1 | 1.12 | 1.02 | 3 | 34.7 | 35.5 |
| **NR 32** | 3.25 | 3.1 | 1.12 | 1.02 | 3 | 36.7 | 37.5 |
| **NR 35** | 3.25 | 3.1 | 1.12 | 1.02 | 3 | 39.7 | 40.5 |
| **NR 37** | 3.25 | 3.1 | 1.12 | 1.02 | 3 | 41.3 | 42 |
| **NR 40** | 3.25 | 3.1 | 1.12 | 1.02 | 3 | 44.6 | 45.5 |
| **NR 42** | 3.25 | 3.1 | 1.12 | 1.02 | 3 | 46.3 | 47 |
| **NR 44** | 3.25 | 3.1 | 1.12 | 1.02 | 3 | 48.3 | 49 |
| **NR 47** | 4.04 | 3.89 | 1.12 | 1.02 | 4 | 52.7 | 53.5 |
| **NR 50** | 4.04 | 3.89 | 1.12 | 1.02 | 4 | 55.7 | 56.5 |
| **NR 52** | 4.04 | 3.89 | 1.12 | 1.02 | 4 | 57.9 | 58.5 |
| **NR 55** | 4.04 | 3.89 | 1.12 | 1.02 | 4 | 60.7 | 61.5 |
| **NR 56** | 4.04 | 3.89 | 1.12 | 1.02 | 4 | 61.7 | 62.5 |
| **NR 58** | 4.04 | 3.89 | 1.12 | 1.02 | 4 | 63.7 | 64.5 |
| **NR 62** | 4.04 | 3.89 | 1.7 | 1.6 | 4 | 67.7 | 68.5 |
| **NR 65** | 4.04 | 3.89 | 1.7 | 1.6 | 4 | 70.7 | 71.5 |
| **NR 68** | 4.85 | 4.7 | 1.7 | 1.6 | 5 | 74.6 | 76 |
| **NR 72** | 4.85 | 4.7 | 1.7 | 1.6 | 5 | 78.6 | 80 |
| **NR 75** | 4.85 | 4.7 | 1.7 | 1.6 | 5 | 81.6 | 83 |
| **NR 80** | 4.85 | 4.7 | 1.7 | 1.6 | 5 | 86.6 | 88 |
| **NR 85** | 4.85 | 4.7 | 1.7 | 1.6 | 5 | 91.6 | 93 |
| **NR 90** | 4.85 | 4.7 | 2.46 | 2.36 | 5 | 96.5 | 98 |
| **NR 95** | 4.85 | 4.7 | 2.46 | 2.36 | 5 | 101.6 | 103 |
| **NR 100** | 4.85 | 4.7 | 2.46 | 2.36 | 5 | 106.5 | 108 |
| **NR 110** | 4.85 | 4.7 | 2.46 | 2.36 | 5 | 116.6 | 118 |
| **NR 115** | 4.85 | 4.7 | 2.46 | 2.36 | 5 | 121.6 | 123 |
| **NR 120** | 7.21 | 7.06 | 2.82 | 2.72 | 7 | 129.7 | 131.5 |
| **NR 125** | 7.21 | 7.06 | 2.82 | 2.72 | 7 | 134.7 | 136.5 |
| **NR 130** | 7.21 | 7.06 | 2.82 | 2.72 | 7 | 139.7 | 141.5 |
| **NR 140** | 7.21 | 7.06 | 2.82 | 2.72 | 7 | 149.7 | 152 |
| **NR 145** | 7.21 | 7.06 | 2.82 | 2.72 | 7 | 154.7 | 157 |
| **NR 150** | 7.21 | 7.06 | 2.82 | 2.72 | 7 | 159.7 | 162 |
| **NR 160** | 7.21 | 7.06 | 2.82 | 2.72 | 7 | 169.7 | 172 |
| **NR 170** | 9.6 | 9.45 | 3.1 | 3 | 10 | 182.9 | 185 |
| **NR 180** | 9.6 | 9.45 | 3.1 | 3 | 10 | 192.9 | 195 |
| **NR 190** | 9.6 | 9.45 | 3.1 | 3 | 10 | 202.9 | 205 |
| **NR 200** | 9.6 | 9.45 | 3.1 | 3 | 10 | 212.9 | 215 |

## 6.2 Formulation of Bearing Numbers

Bearing numbers are alphanumeric combinations that indicate the bearing type, boundary dimensions, dimensional and running accuracies, internal clearance, and other related specifications. They consist of basic numbers and supplementary symbols. The boundary dimensions of commonly used bearings mostly conform to the organizational concept of ISO, and the bearing numbers of these standard bearings are specified by JIS B 1513 (Bearing Numbers for Rolling Bearings). Due to a need for more detailed classification, NSK uses auxiliary symbols other than those specified by JIS.

Bearing numbers consist of a basic number and supplementary symbols. The basic number indicates the bearing series (type) and the width and diameter series as shown in Table 6.5. Basic numbers, supplementary symbols, and the meanings of common numbers and symbols are listed in Table 6.6 (Pages A122 and A123). The contact angle symbols and other supplementary designations are shown in successive columns from left to right in Table 6.6.
For reference, some examples of bearing designations are shown here:



## Table 6.5 Bearing Series Symbols

| Bearing Type | Bearing Series Symbols | Type Symbols | Dimension Symbols | |
|---|---|---|---|---|
| | | | Width Symbols | Diameter Symbols |
| Single-Row Deep Groove Ball Bearings | **68** | 6 | (1) | 8 |
| | **69** | 6 | (1) | 9 |
| | **60** | 6 | (1) | 0 |
| | **62** | 6 | (0) | 2 |
| | **63** | 6 | (0) | 3 |
| Single-Row Angular Contact Ball Bearings | **79** | 7 | (1) | 9 |
| | **70** | 7 | (1) | 0 |
| | **72** | 7 | (0) | 2 |
| | **73** | 7 | (0) | 3 |
| Self-Aligning Ball Bearings | **12** | 1 | (0) | 2 |
| | **13** | 1 | (0) | 3 |
| | **22** | (1) | 2 | 2 |
| | **23** | (1) | 2 | 3 |
| Single-Row Cylindrical Roller Bearings | **NU10** | NU | 1 | 0 |
| | **NU2** | NU | (0) | 2 |
| | **NU22** | NU | 2 | 2 |
| | **NU3** | NU | (0) | 3 |
| | **NU23** | NU | 2 | 3 |
| | **NU4** | NU | (0) | 4 |
| | **NJ2** | NJ | (0) | 2 |
| | **NJ22** | NJ | 2 | 2 |
| | **NJ3** | NJ | (0) | 3 |
| | **NJ23** | NJ | 2 | 3 |
| | **NJ4** | NJ | (0) | 4 |
| | **NUP2** | NUP | (0) | 2 |
| | **NUP22** | NUP | 2 | 2 |
| | **NUP3** | NUP | (0) | 3 |
| | **NUP23** | NUP | 2 | 3 |
| | **NUP4** | NUP | (0) | 4 |
| | **N10** | N | 1 | 0 |
| | **N2** | N | (0) | 2 |
| | **N3** | N | (0) | 3 |
| | **N4** | N | (0) | 4 |
| | **NF2** | NF | (0) | 2 |
| | **NF3** | NF | (0) | 3 |
| | **NF4** | NF | (0) | 4 |

| Bearing Type | Bearing Series Symbols | Type Symbols | Dimension Symbols | |
|---|---|---|---|---|
| | | | Width Symbols or Height Symbols | Diameter Symbols |
| Double-Row Cylindrical Roller Bearings | **NNU49** | NNU | 4 | 9 |
| | **NN30** | NN | 3 | 0 |
| Needle Roller Bearings | **NA48** | NA | 4 | 8 |
| | **NA49** | NA | 4 | 9 |
| | **NA59** | NA | 5 | 9 |
| | **NA69** | NA | 6 | 9 |
| Tapered Roller Bearings | **329** | 3 | 2 | 9 |
| | **320** | 3 | 2 | 0 |
| | **330** | 3 | 3 | 0 |
| | **331** | 3 | 3 | 1 |
| | **302** | 3 | 0 | 2 |
| | **322** | 3 | 2 | 2 |
| | **332** | 3 | 3 | 2 |
| | **303** | 3 | 0 | 3 |
| | **323** | 3 | 2 | 3 |
| Spherical Roller Bearings | **230** | 2 | 3 | 0 |
| | **231** | 2 | 3 | 1 |
| | **222** | 2 | 2 | 2 |
| | **232** | 2 | 3 | 2 |
| | **213** (1) | 2 | 0 | 3 |
| | **223** | 2 | 2 | 3 |
| Thrust Ball Bearings with Flat Seats | **511** | 5 | 1 | 1 |
| | **512** | 5 | 1 | 2 |
| | **513** | 5 | 1 | 3 |
| | **514** | 5 | 1 | 4 |
| | **522** | 5 | 2 | 2 |
| | **523** | 5 | 2 | 3 |
| | **524** | 5 | 2 | 4 |
| Spherical Thrust Roller Bearings | **292** | 2 | 9 | 2 |
| | **293** | 2 | 9 | 3 |
| | **294** | 2 | 9 | 4 |

**Note** (1) Bearing Series Symbol 213 should logically be 203, but customarily it is numbered 213.

**Remarks** Numbers in ( ) in the column of width symbols are usually omitted from the bearing number.

## Table 6.6 Formulation of Bearing Numbers

### Basic Numbers

#### Bearing Series Symbols (1)

| Symbol | Meaning |
|---|---|
| 68<br>69<br>60<br>: | Single-Row Deep Groove Ball Bearings |
| 70<br>72<br>73<br>: | Single-Row Angular Contact Ball Bearings |
| 12<br>13<br>22<br>: | Self-Aligning Ball Bearings |
| NU10<br>NJ 2<br>N 3<br>NN 30<br>: | Cylindrical Roller Bearings |
| NA48<br>NA49<br>NA69<br>: | Needle Roller Bearings |
| 320<br>322<br>323<br>: | Tapered Roller Bearings (2) |
| 230<br>222<br>223<br>: | Spherical Roller Bearings |
| 511<br>512<br>513<br>: | Thrust Ball Bearing with Flat Seats |
| 292<br>293<br>294<br>: | Thrust Spherical Roller Bearings |
| HR(4) | High Capacity Tapered Roller Bearings, and others |

#### Bore Number

| Symbol | Meaning |
|---|---|
| | Bearing Bore 1mm |
| 1 | 1 |
| 2 | 2 |
| 3 | 3 |
| ⋮ | ⋮ |
| 9 | 9 |
| 00 | 10 |
| 01 | 12 |
| 02 | 15 |
| 03 | 17 |
| /22 | 22 |
| /28 | 28 |
| /32 | 32 |
| 04(3) | 20 |
| 05 | 25 |
| 06 | 30 |
| ⋮ | ⋮ |
| 88 | 440 |
| 92 | 460 |
| 96 | 480 |
| /500 | 500 |
| /530 | 530 |
| /560 | 560 |
| ⋮ | ⋮ |
| /2 360 | 2 360 |
| /2 500 | 2 500 |

#### Contact Angle Symbol

| Symbol | Meaning |
|---|---|
| **Angular Contact Ball Bearings** | |
| A | Standard Contact Angle of 30° |
| A5 | Standard Contact Angle of 25° |
| B | Standard Contact Angle of 40° |
| C | Standard Contact Angle of 15° |
| **Contact Angle in Tapered Roller Bearings** | |
| Omitted | Less than 17° |
| C | about 20° |
| D | about 28° |

### Internal Design Symbol

| Symbol | Meaning |
|---|---|
| A | Internal Design Differs from Standard One |
| J | Smaller Diameter of Outer Ring Raceway, Contact Angle, and Outer Ring Width of Tapered Roller Bearings Conform to ISO 355 |
| **For High Capacity Bearings** | |
| C<br>CA<br>CD<br>EA | Spherical Roller Bearings |
| E | Cylindrical Roller Bearings |
| E | Spherical Thrust Roller Bearings |

### Material Symbol

| Symbol | Meaning |
|---|---|
| g | Case-Hardened Steel Used in Rings, Rolling Elements |
| h | Stainless Steel Used in Rings, Rolling Elements |

### Cage Symbol

| Symbol | Meaning |
|---|---|
| M | Machined Brass Cage |
| W | Pressed Steel Cage |
| T | Synthetic Resin Cage |
| V | Without Cage |

### External Features

#### Seals, Shields Symbol

| Symbol | Meaning |
|---|---|
| Z<br>ZS | Shield on One Side Only |
| ZZ<br>ZZS | Shields on Both Sides |
| DU | Contact Rubber Seal on One Side Only |
| DDU | Contact Rubber Seals on Both Sides |
| V | Non-Contact Rubber Seal on One Side Only |
| VV | Non-Contact Rubber Seals on Both Sides |

| Symbols and Numbers Conform to JIS(5) | NSK Symbol | NSK Symbol |
|---|---|---|
| Marked on Bearings | | Not Marked on Bearings |

**Notes**
(1) Bearing Series Symbols conform to Table 6.5.
(2) For basic numbers of tapered roller bearings in ISO's new series, refer to Page B200.
(3) For Bearing Bore Numbers 04 through 96, five times the bore number gives the bore size (mm) (except double-direction thrust ball bearings).
(4) HR is prefix to bearing series symbols and it is NSK's original prefix.

Auxiliary Symbols

| Symbol for Design of Rings | | Arrangement Symbol | | Internal Clearance Symbol Preload Symbol | | | Tolerance Class Symbol | | Special Specification Symbol | | Spacer or Sleeve Symbol | | Grease Symbol | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Symbol | Meaning | Symbol | Meaning | Symbol | | Meaning (radial clearance) | Symbol | Meaning | Symbol | Meaning | Symbol | Meaning | Symbol | Meaning |
| K | Tapered Bore of Inner Ring (Taper 1:12) | DB | Back-to-Back Arrangement | C1 | For All Radial Brgs. | Clearance Less than C2 | Omitted | ISO Normal | **Bearings treated for Dimensional Stabilization** | | +K | Bearings with Outer Ring Spacers | AS2 | SHELL ALVANIA GREASE S2 |
| K30 | Tapered Bore of Inner Ring (Taper 1:30) | DF | Face-to-Face Arrangement | C2 | | Clearance Less than CN | P6 | ISO Class 6 | X26 | Working Temperature Lower than 150 °C | +L | Bearings with Inner Ring Spacers | ENS | ENS GREASE |
| E | Notch or Lubricating Groove in Ring | DT | Tandem Arrangement | Omitted | | CN Clearance | P6X | ISO Class 6X | X28 | Working Temperature Lower than 200 °C | +KL | Bearings with Both Inner and Outer Ring Spacers | NS7 | NS HI-LUBE |
| E4 | Lubricating Groove in Outside Surface and Holes in Outer Ring | | | C3 | | Clearance Greater than CN | P5 | ISO Class 5 | X29 | Working Temperature Lower than 250 °C | H | Adapter Designation | PS2 | MULTEMP PS No. 2 |
| N | Snap Ring Groove in Outer Ring | | | C4 | | Clearance Greater than C3 | P4 | ISO Class 4 | | | AH | Withdrawal Sleeve Designation | | |
| NR | Snap Ring Groove with Snap Ring in Outer Ring | | | C5 | | Clearance Greater than C4 | P2 | ISO Class 2 | | | HJ | Thrust Collar Designation | | |
| | | | | CC1 | For Non-Interchangeable Cylindrical Roller Brgs. | Clearance Less than CC2 | **ABMA(7) Tapered roller bearing** | | **Spherical Roller Bearings** | | | | | |
| | | | | CC2 | | Clearance Less than CC | Omitted | Class 4 | S11 | Dimensional Stabilizing Treatment Working Temperature Lower than 200 °C | | | | |
| | | | | CC | | Normal Clearance | PN2 | Class 2 | | | | | | |
| | | | | CC3 | | Clearance Greater than CC | PN3 | Class 3 | | | | | | |
| | | | | CC4 | | Clearance Greater than CC3 | PN0 | Class 0 | | | | | | |
| | | | | CC5 | | Clearance Greater than CC4 | PN00 | Class 00 | | | | | | |
| | | | | MC1 | For Extra-Small and Miniature Ball Brgs. | Clearance Less than MC2 | | | | | | | | | |
| | | | | MC2 | | Clearance Less than MC3 | | | | | | | | |
| | | | | MC3 | | Normal Clearance | | | | | | | | |
| | | | | MC4 | | Clearance Greater than MC3 | | | | | | | | |
| | | | | MC5 | | Clearance Greater than MC4 | | | | | | | | |
| | | | | MC6 | | Clearance Greater than MC5 | | | | | | | | |
| | | | | CM | | Clearance in Deep Groove Ball Bearings for Electric Motors | | | | | | | | |
| | | | | CT CM | | Clearance in Cylindrical Roller Bearings for Electric Motors | | | | | | | | |
| | | | | **Preload of Angular Contact Ball Bearing** | | | | | | | | | | |
| | | | | EL | | Extra light Preload | | | | | | | | |
| | | | | L | | Light Preload | | | | | | | | |
| | | | | M | | Medium Preload | | | | | | | | |
| | | | | H | | Heavy Preload | | | | | | | | |
| Partially the same as JIS(5) | | Same as JIS(5) | | NSK Symbol | | Partially the same as JIS(5)/ BAS(6) | Same as JIS(5) | | NSK Symbol, Partially the same as JIS(5) | | | | | |
| In Principle, Marked on Bearings | | | | | | | | | | | Not Marked on Bearings | | | |

**Notes** (5) JIS : Japanese Industrial Standards.
(6) BAS : The Japan Bearing Industrial Association Standard.
(7) ABMA : The American Bearing Manufacturers Association.




MAG



## 7. BEARING TOLERANCES

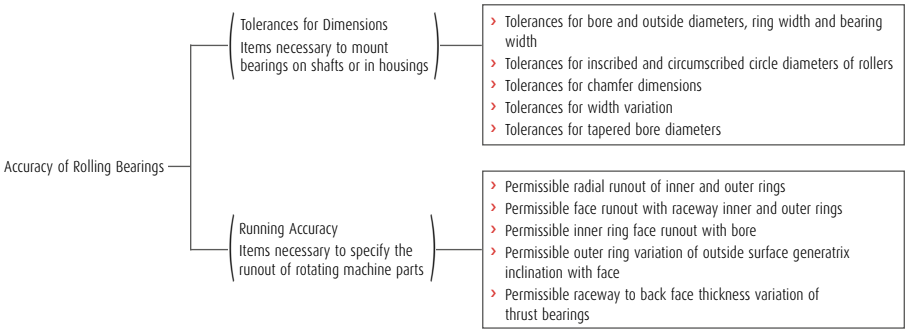
7.1 Bearing Tolerance Standards ..... A 126
7.2 Selection of Accuracy Classes ..... A 151

# 7. Bearing Tolerances

## 7.1 Bearing Tolerance Standards

The tolerances for the boundary dimensions and running accuracy of rolling bearings are specified by ISO 492/199/582 (Accuracies of Rolling Bearings). Tolerances are specified for the following items:

Regarding bearing accuracy classes, besides ISO normal accuracy, as the accuracy improves there are Class 6X (for tapered roller bearings), Class 6, Class 5, Class 4, and Class 2, with Class 2 being the highest in ISO. The applicable accuracy classes for each bearing type and the correspondence of these classes are shown in Table 7.1.




### Table 7.1 Bearing Types and Tolerance Classes

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Deep Groove Ball Bearings | | | | | ISO 492 | Normal | – | Class 6 | Class 5 | Class 4 | Class 2 |
| Angular Contact Ball Bearings | | | | | | Normal | – | Class 6 | Class 5 | Class 4 | Class 2 |
| Self-Aligning Ball Bearings | | | | | | Normal | – | Class 6 Equivalent | Class 5 Equivalent | – | – |
| Cylindrical Roller Bearings | | | | | | Normal | – | Class 6 | Class 5 | Class 4 | Class 2 |
| Needle Roller Bearings | | | | | | Normal | – | Class 6 | Class 5 | Class 4 | – |
| Spherical Roller Bearings | | | | | | Normal | – | Class 6 | Class 5 | – | – |
| Tapered Roller Bearings | Metric Design | | | | ISO 492 | Normal | Class 6X | Class 6 | Class 5 | Class 4 | - |
| | Inch Design | | | | ANSI/AFBMA Std.19.2 | Class 4 | - | Class 2 | Class 3 | Class 0 | Class 00 |
| | J Series | | | | ANSI/AFBMA Std.19.1 | Class K | Class N | - | Class C | Class B | - |
| Magneto Bearings | | | | | BAS1061 | Normal | - | Class 6 | Class 5 | - | - |
| Thrust Ball Bearings | | | | | ISO 199 | Normal | - | Class 6 | Class 5 | Class 4 | - |
| Thrust Roller Bearings | | | | | | Normal | - | - | - | - | - |
| Thrust Spherical Roller Bearings | | | | | | Normal | - | - | - | - | - |
| Equivalent standards (Reference) | JIS(1) | | | | JIS B 1514,1536 | Class 0 | - | Class 6 | Class 5 | Class 4 | Class 2 |
| | | Tapered Roller Bearings | Metric Design | | JIS B 1514 | Class 0 | Class 6X | (Class 6) | Class 5 | Class 4 | - |
| | DIN(2) | | | | DIN620 | P0 | - | P6 | P5 | P4 | P2 |
| | ANSI/AFBMA(3) | Ball Bearings | | | ANSI/AFBMA Std.20 | ABEC1 | - | ABEC3 | ABEC5 | ABEC7 | ABEC9 |
| | | Roller Bearings | | | | RBEC1 | - | RBEC3 | RBEC5 | - | - |
| | | Instrument Ball Bearings | | | ANSI/AFBMA Std.12.2 | - | - | - | Class 5P | Class 7P | Class 9P |
| | | Tapered Roller Bearings | Metric Design | | ANSI/AFBMA Std.19.1 | Class K | Class N | - | Class C | Class B | Class A |
| | BAS | Tapered Roller Bearings | Metric Design | Multi/ Four-Row | BAS1002 | Class 0 | - | - | - | - | - |

**Notes**
(1) JIS : Japanese Industrial Standards
(2) DIN : Deutches Institut fuer Normung
(3) ANSI/AFBMA : The American Bearing Manufacturers Association

**Remarks** The permissible limit of chamfer dimensions shall conform to Table 7.10 (Page A148 and A149), and the tolerances and permissible tapered bore diameters shall conform to Table 7.11 (Page A150 and A151).

## Reference

Rough definitions of the items listed for Running Accuracy and their measuring methods are shown in Fig. 7.1, and they are described in detail in ISO 5593 (Rolling Bearings-Vocabulary) and JIS B 1515 (Rolling Bearings-Tolerances) and elsewhere.

## Supplementary Table

| Running Accuracy | Inner Ring | Outer Ring | Dial Gauge |
|---|---|---|---|
| $K_{ia}$ | Rotating | Stationary | A |
| $K_{ea}$ | Stationary | Rotating | A |
| $S_{ia}$ | Rotating | Stationary | $B_1$ |
| $S_{ea}$ | Stationary | Rotating | $B_2$ |
| $S_d$ | Rotating | Stationary | C |
| $S_D$ | – | Rotating | D |
| $S_i$ , $S_e$ | Only the shaft or housing or central washer is to be rotated. | | E |

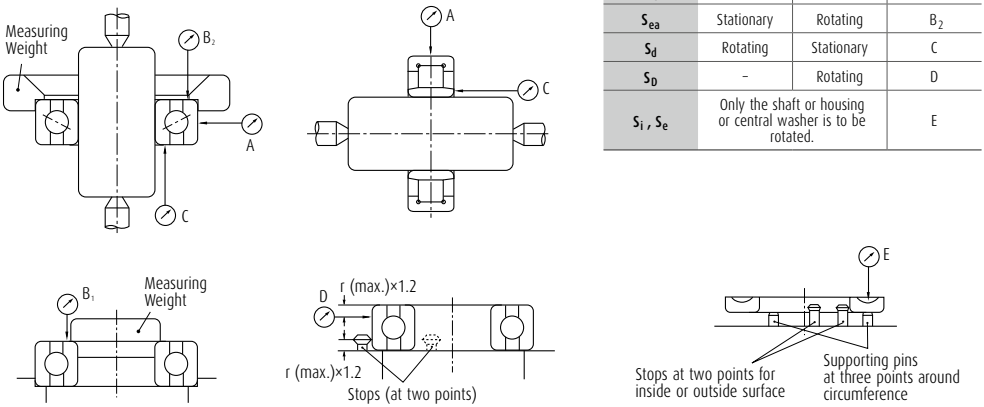
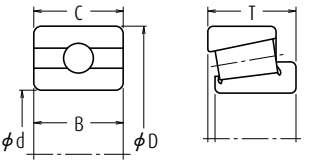



Fig. 7.1 Measuring Methods for Running Accuracy (summarized)

### Symbols for Boundary Dimensions and Running Accuracy

| | |
|---|---|
| d | Brg. bore dia., nominal |
| $\Delta_{ds}$ | Deviation of a single bore dia. |
| $\Delta_{dmp}$ | Single plane mean bore dia. deviation |
| $V_{dp}$ | Bore dia. Variation in a single radial plane |
| $V_{dmp}$ | Mean bore dia. Variation |
| B | Inner ring width, nominal |
| $\Delta_{Bs}$ | Deviation of a single inner ring width |
| $V_{Bs}$ | Inner ring width variation |
| $K_{ia}$ | Radial runout of assembles brg. inner ring |
| $S_d$ | inner ring reference face (backface, where applicable) runout with bore |
| $S_{ia}$ | Assembled brg. inner ring face (back face) runout with raceway |
| $S_i$, $S_e$ | Raceway to backface thickness variation of thrust brg. |
| T | Brg width, nominal |
| $\Delta_{Ts}$ | Deviation of the actual brg. width |
| D | Brg. outside dia., nominal |
| $\Delta_{Ds}$ | Deviation of a single outside dia. |
| $\Delta_{Dmp}$ | Single plane mean outside dia. Deviation |
| $V_{Dp}$ | Outside dia. Variation in a single radial plane |
| $V_{Dmp}$ | Mean outside dia. Variation |
| C | Outer ring width, nominal |
| $\Delta_{Cs}$ | Deviation of a single outer ring width |
| $V_{Cs}$ | Outer ring width variation |
| $K_{ea}$ | Radial runout of assembled brg. outer ring |
| $S_D$ | Variation of brg. outside surface generatrix inclination with outer ring reference face (backface) |
| $S_{ea}$ | Assembled brg. outer ring face (backface) runout with raceway |



## Table 7.2 Tolerances for Radial Bearings (excluding Tapered Roller Bearings)
## Table 7.2.1 Tolerances for Inner Rings and Widths of Outer Rings

| Nominal Bore Diameter d (mm) | | $\Delta_{dmp}$(2) | | | | | | | | | | $\Delta_{ds}$(2) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Normal | | Class 6 | | Class 5 | | Class 4 | | Class 2 | | Class 4 Diameter Series 0, 1, 2, 3, 4 | | Class 2 | |
| over | incl. | high | low | high | low | high | low | high | low | high | low | high | low | high | low |
| 0.6(1) | 2.5 | 0 | -8 | 0 | -7 | 0 | -5 | 0 | -4 | 0 | -2.5 | 0 | -4 | 0 | -2.5 |
| 2.5 | 10 | 0 | -8 | 0 | -7 | 0 | -5 | 0 | -4 | 0 | -2.5 | 0 | -4 | 0 | -2.5 |
| 10 | 18 | 0 | -8 | 0 | -7 | 0 | -5 | 0 | -4 | 0 | -2.5 | 0 | -4 | 0 | -2.5 |
| 18 | 30 | 0 | -10 | 0 | -8 | 0 | -6 | 0 | -5 | 0 | -2.5 | 0 | -5 | 0 | -2.5 |
| 30 | 50 | 0 | -12 | 0 | -10 | 0 | -8 | 0 | -6 | 0 | -2.5 | 0 | -6 | 0 | -2.5 |
| 50 | 80 | 0 | -15 | 0 | -12 | 0 | -9 | 0 | -7 | 0 | -4 | 0 | -7 | 0 | -4 |
| 80 | 120 | 0 | -20 | 0 | -15 | 0 | -10 | 0 | -8 | 0 | -5 | 0 | -8 | 0 | -5 |
| 120 | 150 | 0 | -25 | 0 | -18 | 0 | -13 | 0 | -10 | 0 | -7 | 0 | -10 | 0 | -7 |
| 150 | 180 | 0 | -25 | 0 | -18 | 0 | -13 | 0 | -10 | 0 | -7 | 0 | -10 | 0 | -7 |
| 180 | 250 | 0 | -30 | 0 | -22 | 0 | -15 | 0 | -12 | 0 | -8 | 0 | -12 | 0 | -8 |
| 250 | 315 | 0 | -35 | 0 | -25 | 0 | -18 | – | – | – | – | – | – | – | – |
| 315 | 400 | 0 | -40 | 0 | -30 | 0 | -23 | – | – | – | – | – | – | – | – |
| 400 | 500 | 0 | -45 | 0 | -35 | – | – | – | – | – | – | – | – | – | – |
| 500 | 630 | 0 | -50 | 0 | -40 | – | – | – | – | – | – | – | – | – | – |
| 630 | 800 | 0 | -75 | – | – | – | – | – | – | – | – | – | – | – | – |
| 800 | 1 000 | 0 | -100 | – | – | – | – | – | – | – | – | – | – | – | – |
| 1 000 | 1 250 | 0 | -125 | – | – | – | – | – | – | – | – | – | – | – | – |
| 1 250 | 1 600 | 0 | -160 | – | – | – | – | – | – | – | – | – | – | – | – |
| 1 600 | 2 000 | 0 | -200 | – | – | – | – | – | – | – | – | – | – | – | – |

| Nominal Bore Diameter d (mm) | | $\Delta_{Bs}$ (or $\Delta_{Cs}$)(3) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Single Bearing | | | | | | Combined Bearings (4) | | | | | |
| | | Normal Class 6 | | Class 5 Class 4 | | Class 2 | | Normal Class 6 | | Class 5 Class 4 | | Class 2 | |
| over | incl. | high | low | high | low | high | low | high | low | high | low | high | low |
| 0.6(1) | 2.5 | 0 | -40 | 0 | -40 | 0 | -40 | – | – | 0 | -250 | 0 | -250 |
| 2.5 | 10 | 0 | -120 | 0 | -40 | 0 | -40 | 0 | -250 | 0 | -250 | 0 | -250 |
| 10 | 18 | 0 | -120 | 0 | -80 | 0 | -80 | 0 | -250 | 0 | -250 | 0 | -250 |
| 18 | 30 | 0 | -120 | 0 | -120 | 0 | -120 | 0 | -250 | 0 | -250 | 0 | -250 |
| 30 | 50 | 0 | -120 | 0 | -120 | 0 | -120 | 0 | -250 | 0 | -250 | 0 | -250 |
| 50 | 80 | 0 | -150 | 0 | -150 | 0 | -150 | 0 | -380 | 0 | -250 | 0 | -250 |
| 80 | 120 | 0 | -200 | 0 | -200 | 0 | -200 | 0 | -380 | 0 | -380 | 0 | -380 |
| 120 | 150 | 0 | -250 | 0 | -250 | 0 | -250 | 0 | -500 | 0 | -380 | 0 | -380 |
| 150 | 180 | 0 | -250 | 0 | -250 | 0 | -250 | 0 | -500 | 0 | -380 | 0 | -380 |
| 180 | 250 | 0 | -300 | 0 | -300 | 0 | -300 | 0 | -500 | 0 | -500 | 0 | -500 |
| 250 | 315 | 0 | -350 | 0 | -350 | – | – | 0 | -500 | 0 | -500 | – | – |
| 315 | 400 | 0 | -400 | 0 | -400 | – | – | 0 | -630 | 0 | -630 | – | – |
| 400 | 500 | 0 | -450 | – | – | – | – | – | – | – | – | – | – |
| 500 | 630 | 0 | -500 | – | – | – | – | – | – | – | – | – | – |
| 630 | 800 | 0 | -750 | – | – | – | – | – | – | – | – | – | – |
| 800 | 1 000 | 0 | -1 000 | – | – | – | – | – | – | – | – | – | – |
| 1 000 | 1 250 | 0 | -1 250 | – | – | – | – | – | – | – | – | – | – |
| 1 250 | 1 600 | 0 | -1 600 | – | – | – | – | – | – | – | – | – | – |
| 1 600 | 2 000 | 0 | -2 000 | – | – | – | – | – | – | – | – | – | – |

**Notes**

(1) 0.6 mm is included in the group.
(2) Applicable to bearings with cylindrical bores.
(3) Tolerance for width deviation and tolerance limits for the width variation of the outer ring should be the same bearing. Tolerances for the width variation of the outer ring of Class 5, 4, and 2 are shown in Table 7.2.2.
(4) Applicable to individual rings manufactured for combined bearings.
(5) Applicable to ball bearings such as deep groove ball bearings, angular contact ball bearings, etc..

| $V_{dp}$(2) | | | | | | | | | | | | $V_{dmp}$(2) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Normal | | | Class 6 | | | Class 5 | | Class 4 | | Class 2 | | Normal | Class 6 | Class 5 | Class 4 | Class 2 |
| Diameter Series | | | Diameter Series | | | Diameter Series | | Diameter Series | | Diameter Series | | | | | | |
| 9 | 0, 1 | 2, 3, 4 | 9 | 0, 1 | 2, 3, 4 | 9 | 0,1,2,3,4 | 9 | 0,1,2,3,4 | 0, 1, 2, 3, 4 | | | | | | |
| max. | | | max. | | | max. | | max. | | max. | | max. | max. | max. | max. | max. |
| 10 | 8 | 6 | 9 | 7 | 5 | 5 | 4 | 4 | 3 | 2.5 | | 6 | 5 | 3 | 2 | 1.5 |
| 10 | 8 | 6 | 9 | 7 | 5 | 5 | 4 | 4 | 3 | 2.5 | | 6 | 5 | 3 | 2 | 1.5 |
| 10 | 8 | 6 | 9 | 7 | 5 | 5 | 4 | 4 | 3 | 2.5 | | 6 | 5 | 3 | 2 | 1.5 |
| 13 | 10 | 8 | 10 | 8 | 6 | 6 | 5 | 5 | 4 | 2.5 | | 8 | 6 | 3 | 2.5 | 1.5 |
| 15 | 12 | 9 | 13 | 10 | 8 | 8 | 6 | 6 | 5 | 2.5 | | 9 | 8 | 4 | 3 | 1.5 |
| 19 | 19 | 11 | 15 | 15 | 9 | 9 | 7 | 7 | 5 | 4 | | 11 | 9 | 5 | 3.5 | 2 |
| 25 | 25 | 15 | 19 | 19 | 11 | 10 | 8 | 8 | 6 | 5 | | 15 | 11 | 5 | 4 | 2.5 |
| 31 | 31 | 19 | 23 | 23 | 14 | 13 | 10 | 10 | 8 | 7 | | 19 | 14 | 7 | 5 | 3.5 |
| 31 | 31 | 19 | 23 | 23 | 14 | 13 | 10 | 10 | 8 | 7 | | 19 | 14 | 7 | 5 | 3.5 |
| 38 | 38 | 23 | 28 | 28 | 17 | 15 | 12 | 12 | 9 | 8 | | 23 | 17 | 8 | 6 | 4 |
| 44 | 44 | 26 | 31 | 31 | 19 | 18 | 14 | – | – | – | | 26 | 19 | 9 | – | – |
| 50 | 50 | 30 | 38 | 38 | 23 | 23 | 18 | – | – | – | | 30 | 23 | 12 | – | – |
| 56 | 56 | 34 | 44 | 44 | 26 | – | – | – | – | – | | 34 | 26 | – | – | – |
| 63 | 63 | 38 | 50 | 50 | 30 | – | – | – | – | – | | 38 | 30 | – | – | – |
| – | – | – | – | – | – | – | – | – | – | – | | – | – | – | – | – |
| – | – | – | – | – | – | – | – | – | – | – | | – | – | – | – | – |
| – | – | – | – | – | – | – | – | – | – | – | | – | – | – | – | – |
| – | – | – | – | – | – | – | – | – | – | – | | – | – | – | – | – |
| – | – | – | – | – | – | – | – | – | – | – | | – | – | – | – | – |

7

Units : µm

| $V_{Bs}$ (or $V_{Cs}$) | | | | | $K_{ia}$ | | | | | $S_d$ | | | $S_{ia}$(5) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inner Ring (or Outer Ring) (3) | | Inner Ring | | | Normal | Class 6 | Class 5 | Class 4 | Class 2 | Class 5 | Class 4 | Class 2 | Class 5 | Class 4 | Class 2 |
| Normal | Class 6 | Class 5 | Class 4 | Class 2 | max. | max. | max. | max. | max. | max. | max. | max. | max. | max. | max. |
| max. | max. | max. | max. | max. | | | | | | | | | | | |
| 12 | 12 | 5 | 2.5 | 1.5 | 10 | 5 | 4 | 2.5 | 1.5 | 7 | 3 | 1.5 | 7 | 3 | 1.5 |
| 15 | 15 | 5 | 2.5 | 1.5 | 10 | 6 | 4 | 2.5 | 1.5 | 7 | 3 | 1.5 | 7 | 3 | 1.5 |
| 20 | 20 | 5 | 2.5 | 1.5 | 10 | 7 | 4 | 2.5 | 1.5 | 7 | 3 | 1.5 | 7 | 3 | 1.5 |
| 20 | 20 | 5 | 2.5 | 1.5 | 13 | 8 | 4 | 3 | 2.5 | 8 | 4 | 1.5 | 8 | 4 | 2.5 |
| 20 | 20 | 5 | 3 | 1.5 | 15 | 10 | 5 | 4 | 2.5 | 8 | 4 | 1.5 | 8 | 4 | 2.5 |
| 25 | 25 | 6 | 4 | 1.5 | 20 | 10 | 5 | 4 | 2.5 | 8 | 5 | 1.5 | 8 | 5 | 2.5 |
| 25 | 25 | 7 | 4 | 2.5 | 25 | 13 | 6 | 5 | 2.5 | 9 | 5 | 2.5 | 9 | 5 | 2.5 |
| 30 | 30 | 8 | 5 | 2.5 | 30 | 18 | 8 | 6 | 2.5 | 10 | 6 | 2.5 | 10 | 7 | 2.5 |
| 30 | 30 | 8 | 5 | 4 | 30 | 18 | 8 | 6 | 5 | 10 | 6 | 4 | 10 | 7 | 5 |
| 30 | 30 | 10 | 6 | 5 | 40 | 20 | 10 | 8 | 5 | 11 | 7 | 5 | 13 | 8 | 5 |
| 35 | 35 | 13 | – | – | 50 | 25 | 13 | – | – | 13 | – | – | 15 | – | – |
| 40 | 40 | 15 | – | – | 60 | 30 | 15 | – | – | 15 | – | – | 20 | – | – |
| 50 | 45 | – | – | – | 65 | 35 | – | – | – | – | – | – | – | – | – |
| 60 | 50 | – | – | – | 70 | 40 | – | – | – | – | – | – | – | – | – |
| 70 | – | – | – | – | 80 | – | – | – | – | – | – | – | – | – | – |
| 80 | – | – | – | – | 90 | – | – | – | – | – | – | – | – | – | – |
| 100 | – | – | – | – | 100 | – | – | – | – | – | – | – | – | – | – |
| 120 | – | – | – | – | 120 | – | – | – | – | – | – | – | – | – | – |
| 140 | – | – | – | – | 140 | – | – | – | – | – | – | – | – | – | – |

**Remarks**

1. The cylindrical bore diameter "no-go side" tolerance limit (high) specified in this table does not necessarily apply within a distance of 1.2 times the chamfer dimension r (max.) from the ring face.
2. ABMA Std 20-1996: ABEC1·RBEC1, ABEC3·RBEC3, ABEC5·RBEC5, ABEC7·RBEC7, and ABEC9·RBEC9 are equivalent to Classes Normal, 6, 5, 4, and 2 respectively.

## Table 7.2 Tolerances for Radial Bearings (excluding Tapered Roller Bearings)
## Table 7.2.2 Tolerances for Outer Rings

| Nominal Outside Diameter D (mm) | | $\Delta_{Dmp}$ | | | | | | | | | | $\Delta_{Ds}$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Normal | | Class 6 | | Class 5 | | Class 4 | | Class 2 | | Class 4 Diameter Series 0, 1, 2, 3, 4 | | Class 2 | |
| over | incl. | high | low | high | low | high | low | high | low | high | low | high | low | high | low |
| 2.5 (1) | 6 | 0 | -8 | 0 | -7 | 0 | -5 | 0 | -4 | 0 | -2.5 | 0 | -4 | 0 | -2.5 |
| 6 | 18 | 0 | -8 | 0 | -7 | 0 | -5 | 0 | -4 | 0 | -2.5 | 0 | -4 | 0 | -2.5 |
| 18 | 30 | 0 | -9 | 0 | -8 | 0 | -6 | 0 | -5 | 0 | -4 | 0 | -5 | 0 | -4 |
| 30 | 50 | 0 | -11 | 0 | -9 | 0 | -7 | 0 | -6 | 0 | -4 | 0 | -6 | 0 | -4 |
| 50 | 80 | 0 | -13 | 0 | -11 | 0 | -9 | 0 | -7 | 0 | -4 | 0 | -7 | 0 | -4 |
| 80 | 120 | 0 | -15 | 0 | -13 | 0 | -10 | 0 | -8 | 0 | -5 | 0 | -8 | 0 | -5 |
| 120 | 150 | 0 | -18 | 0 | -15 | 0 | -11 | 0 | -9 | 0 | -5 | 0 | -9 | 0 | -5 |
| 150 | 180 | 0 | -25 | 0 | -18 | 0 | -13 | 0 | -10 | 0 | -7 | 0 | -10 | 0 | -7 |
| 180 | 250 | 0 | -30 | 0 | -20 | 0 | -15 | 0 | -11 | 0 | -8 | 0 | -11 | 0 | -8 |
| 250 | 315 | 0 | -35 | 0 | -25 | 0 | -18 | 0 | -13 | 0 | -8 | 0 | -13 | 0 | -8 |
| 315 | 400 | 0 | -40 | 0 | -28 | 0 | -20 | 0 | -15 | 0 | -10 | 0 | -15 | 0 | -10 |
| 400 | 500 | 0 | -45 | 0 | -33 | 0 | -23 | – | – | – | – | – | – | – | – |
| 500 | 630 | 0 | -50 | 0 | -38 | 0 | -28 | – | – | – | – | – | – | – | – |
| 630 | 800 | 0 | -75 | 0 | -45 | 0 | -35 | – | – | – | – | – | – | – | – |
| 800 | 1 000 | 0 | -100 | 0 | -60 | – | – | – | – | – | – | – | – | – | – |
| 1 000 | 1 250 | 0 | -125 | – | – | – | – | – | – | – | – | – | – | – | – |
| 1 250 | 1 600 | 0 | -160 | – | – | – | – | – | – | – | – | – | – | – | – |
| 1 600 | 2 000 | 0 | -200 | – | – | – | – | – | – | – | – | – | – | – | – |
| 2 000 | 2 500 | 0 | -250 | – | – | – | – | – | – | – | – | – | – | – | – |

**Notes**

(1) 2.5 mm is included in the group.
(2) Applicable only when a locating snap ring is not used.
(3) Applicable to ball bearings such as deep groove ball bearings and angular contact ball bearings.
(4) The tolerances for outer ring width variation of bearings of Classes Normal and 6 are shown in Table 7.2.1.

**Remarks**

1. The outside diameter "no-go side" tolerances (low) specified in this table do not necessarily apply within a distance of 1.2 times the chamfer dimension r (max.) from the ring face.
2. ABMA Std 20-1996: ABEC1·RBEC1, ABEC3·RBEC3, ABEC5·RBEC5, ABEC7·RBEC7, and ABEC9·RBEC9 are equivalent to Classes Normal, 6, 5, 4, and 2 respectively.

| $V_{Dp}$(2) | | | | | | | | | | | | | | $V_{Dmp}$(2) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Normal | | | | Class 6 | | | | Class 5 | | Class 4 | | Class 2 | | Normal | Class 6 | Class 5 | Class 4 | Class 2 |
| Open Type | | | Shielded Sealed | Open Type | | | Shielded Sealed | Open Type | | Open Type | | Open Type | | | | | | |
| Diameter Series | | | | Diameter Series | | | | Diameter Series | | Diameter Series | | Diameter Series | | | | | | |
| 9 | 0, 1 | 2,3,4 | 2, 3, 4 | 9 | 0,1 | 2,3,4 | 0, 1, 2, 3, 4 | 9 | 0,1,2,3,4 | 9 | 0,1,2,3,4 | 0, 1, 2, 3, 4 | | | | | | |
| max. | | | | max. | | | | max. | | max. | | max. | | max. | max. | max. | max. | max. |
| 10 | 8 | 6 | 10 | 9 | 7 | 5 | 9 | 5 | 4 | 4 | 3 | 2.5 | | 6 | 5 | 3 | 2 | 1.5 |
| 10 | 8 | 6 | 10 | 9 | 7 | 5 | 9 | 5 | 4 | 4 | 3 | 2.5 | | 6 | 5 | 3 | 2 | 1.5 |
| 12 | 9 | 7 | 12 | 10 | 8 | 6 | 10 | 6 | 5 | 5 | 4 | 4 | | 7 | 6 | 3 | 2.5 | 2 |
| 14 | 11 | 8 | 16 | 11 | 9 | 7 | 13 | 7 | 5 | 6 | 5 | 4 | | 8 | 7 | 4 | 3 | 2 |
| 16 | 13 | 10 | 20 | 14 | 11 | 8 | 16 | 9 | 7 | 7 | 5 | 4 | | 10 | 8 | 5 | 3.5 | 2 |
| 19 | 19 | 11 | 26 | 16 | 16 | 10 | 20 | 10 | 8 | 8 | 6 | 5 | | 11 | 10 | 5 | 4 | 2.5 |
| 23 | 23 | 14 | 30 | 19 | 19 | 11 | 25 | 11 | 8 | 9 | 7 | 5 | | 14 | 11 | 6 | 5 | 2.5 |
| 31 | 31 | 19 | 38 | 23 | 23 | 14 | 30 | 13 | 10 | 10 | 8 | 7 | | 19 | 14 | 7 | 5 | 3.5 |
| 38 | 38 | 23 | – | 25 | 25 | 15 | – | 15 | 11 | 11 | 8 | 8 | | 23 | 15 | 8 | 6 | 4 |
| 44 | 44 | 26 | – | 31 | 31 | 19 | – | 18 | 14 | 13 | 10 | 8 | | 26 | 19 | 9 | 7 | 4 |
| 50 | 50 | 30 | – | 35 | 35 | 21 | – | 20 | 15 | 15 | 11 | 10 | | 30 | 21 | 10 | 8 | 5 |
| 56 | 56 | 34 | – | 41 | 41 | 25 | – | 23 | 17 | – | – | – | | 34 | 25 | 12 | – | – |
| 63 | 63 | 38 | – | 48 | 48 | 29 | – | 28 | 21 | – | – | – | | 38 | 29 | 14 | – | – |
| 94 | 94 | 55 | – | 56 | 56 | 34 | – | 35 | 26 | – | – | – | | 55 | 34 | 18 | – | – |
| 125 | 125 | 75 | – | 75 | 75 | 45 | – | – | – | – | – | – | | 75 | 45 | – | – | – |
| – | – | – | – | – | – | – | – | – | – | – | – | – | | – | – | – | – | – |
| – | – | – | – | – | – | – | – | – | – | – | – | – | | – | – | – | – | – |
| – | – | – | – | – | – | – | – | – | – | – | – | – | | – | – | – | – | – |
| – | – | – | – | – | – | – | – | – | – | – | – | – | | – | – | – | – | – |

7

Units : µm

| Nominal Outside Diameter D (mm) | | $K_{ea}$ | | | | | $S_D$ | | | $S_{ea}$(3) | | | $V_{cs}$(4) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Normal | Class 6 | Class 5 | Class 4 | Class 2 | Class 5 | Class 4 | Class 2 | Class 5 | Class 4 | Class 2 | Class 5 | Class 4 | Class 2 |
| over | incl. | max. | max. | max. | max. | max. | max. | max. | max. | max. | max. | max. | max. | max. | max. |
| 2.5 (1) | 6 | 15 | 8 | 5 | 3 | 1.5 | 8 | 4 | 1.5 | 8 | 5 | 1.5 | 5 | 2.5 | 1.5 |
| 6 | 18 | 15 | 8 | 5 | 3 | 1.5 | 8 | 4 | 1.5 | 8 | 5 | 1.5 | 5 | 2.5 | 1.5 |
| 18 | 30 | 15 | 9 | 6 | 4 | 2.5 | 8 | 4 | 1.5 | 8 | 5 | 2.5 | 5 | 2.5 | 1.5 |
| 30 | 50 | 20 | 10 | 7 | 5 | 2.5 | 8 | 4 | 1.5 | 8 | 5 | 2.5 | 5 | 2.5 | 1.5 |
| 50 | 80 | 25 | 13 | 8 | 5 | 4 | 8 | 4 | 1.5 | 10 | 5 | 4 | 6 | 3 | 1.5 |
| 80 | 120 | 35 | 18 | 10 | 6 | 5 | 9 | 5 | 2.5 | 11 | 6 | 5 | 8 | 4 | 2.5 |
| 120 | 150 | 40 | 20 | 11 | 7 | 5 | 10 | 5 | 2.5 | 13 | 7 | 5 | 8 | 5 | 2.5 |
| 150 | 180 | 45 | 23 | 13 | 8 | 5 | 10 | 5 | 2.5 | 14 | 8 | 5 | 8 | 5 | 2.5 |
| 180 | 250 | 50 | 25 | 15 | 10 | 7 | 11 | 7 | 4 | 15 | 10 | 7 | 10 | 7 | 4 |
| 250 | 315 | 60 | 30 | 18 | 11 | 7 | 13 | 8 | 5 | 18 | 10 | 7 | 11 | 7 | 5 |
| 315 | 400 | 70 | 35 | 20 | 13 | 8 | 13 | 10 | 7 | 20 | 13 | 8 | 13 | 8 | 7 |
| 400 | 500 | 80 | 40 | 23 | – | – | 15 | – | – | 23 | – | – | 15 | – | – |
| 500 | 630 | 100 | 50 | 25 | – | – | 18 | – | – | 25 | – | – | 18 | – | – |
| 630 | 800 | 120 | 60 | 30 | – | – | 20 | – | – | 30 | – | – | 20 | – | – |
| 800 | 1 000 | 140 | 75 | – | – | – | – | – | – | – | – | – | – | – | – |
| 1 000 | 1 250 | 160 | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 1 250 | 1 600 | 190 | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 1 600 | 2 000 | 220 | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 2 000 | 2 500 | 250 | – | – | – | – | – | – | – | – | – | – | – | – | – |

## Table 7.3 Tolerances for Metric Design Tapered Roller Bearings
## Table 7.3.1 Tolerances for Inner Ring Bore Diameter and Running Accuracy

| Nominal Outside Diameter d (mm) | | $\Delta_{dmp}$ | | | | | | $\Delta_{ds}$ | | $V_{dp}$ | | | | $V_{dmp}$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Normal Class 6X | | Class 6 Class 5 | | Class 4 | | Class 4 | | Normal Class 6X | Class 6 | Class 5 | Class 4 | Normal Class 6X | Class 6 | Class 5 | Class 4 |
| over | incl. | high | low | high | low | high | low | high | low | max. | max. | max. | max. | max. | max. | max. | max. |
| 10 | 18 | 0 | -8 | 0 | -7 | 0 | -5 | 0 | -5 | 8 | 7 | 5 | 4 | 6 | 5 | 5 | 4 |
| 18 | 30 | 0 | -10 | 0 | -8 | 0 | -6 | 0 | -6 | 10 | 8 | 6 | 5 | 8 | 6 | 5 | 4 |
| 30 | 50 | 0 | -12 | 0 | -10 | 0 | -8 | 0 | -8 | 12 | 10 | 8 | 6 | 9 | 8 | 5 | 5 |
| 50 | 80 | 0 | -15 | 0 | -12 | 0 | -9 | 0 | -9 | 15 | 12 | 9 | 7 | 11 | 9 | 6 | 5 |
| 80 | 120 | 0 | -20 | 0 | -15 | 0 | -10 | 0 | -10 | 20 | 15 | 11 | 8 | 15 | 11 | 8 | 5 |
| 120 | 180 | 0 | -25 | 0 | -18 | 0 | -13 | 0 | -13 | 25 | 18 | 14 | 10 | 19 | 14 | 9 | 7 |
| 180 | 250 | 0 | -30 | 0 | -22 | 0 | -15 | 0 | -15 | 30 | 22 | 17 | 11 | 23 | 16 | 11 | 8 |
| 250 | 315 | 0 | -35 | 0 | -25 | 0 | -18 | 0 | -18 | 35 | – | – | – | 26 | – | – | – |
| 315 | 400 | 0 | -40 | 0 | -30 | 0 | -23 | 0 | -23 | 40 | – | – | – | 30 | – | – | – |
| 400 | 500 | 0 | -45 | 0 | -35 | 0 | -27 | 0 | -27 | – | – | – | – | – | – | – | – |
| 500 | 630 | 0 | -50 | 0 | -40 | – | – | – | – | – | – | – | – | – | – | – | – |
| 630 | 800 | 0 | -75 | 0 | -60 | – | – | – | – | – | – | – | – | – | – | – | – |

**Remarks**

1. The bore diameter "no-go side" tolerances (high) specified in this table do not necessarily apply within a distance of 1.2 times the chamfer dimension r (max.) from the ring face.
2. Some of these tolerances conform to the NSK Standard.

## Table 7.3.2 Tolerances for Outer Ring Outside Diameter and Running Accuracy

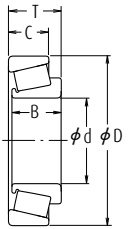
| Nominal Outside Diameter D (mm) | | $\Delta_{Dmp}$ | | | | | | $\Delta_{Ds}$ | | $V_{Dp}$ | | | | $V_{Dmp}$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Normal Class 6X | | Class 6 Class 5 | | Class 4 | | Class 4 | | Normal Class 6X | Class 6 | Class 5 | Class 4 | Normal Class 6X | Class 6 | Class 5 | Class 4 |
| over | incl. | high | low | high | low | high | low | high | low | max. | max. | max. | max. | max. | max. | max. | max. |
| 18 | 30 | 0 | -9 | 0 | -8 | 0 | -6 | 0 | -6 | 9 | 8 | 6 | 5 | 7 | 6 | 5 | 4 |
| 30 | 50 | 0 | -11 | 0 | -9 | 0 | -7 | 0 | -7 | 11 | 9 | 7 | 5 | 8 | 7 | 5 | 5 |
| 50 | 80 | 0 | -13 | 0 | -11 | 0 | -9 | 0 | -9 | 13 | 11 | 8 | 7 | 10 | 8 | 6 | 5 |
| 80 | 120 | 0 | -15 | 0 | -13 | 0 | -10 | 0 | -10 | 15 | 13 | 10 | 8 | 11 | 10 | 7 | 5 |
| 120 | 150 | 0 | -18 | 0 | -15 | 0 | -11 | 0 | -11 | 18 | 15 | 11 | 8 | 14 | 11 | 8 | 6 |
| 150 | 180 | 0 | -25 | 0 | -18 | 0 | -13 | 0 | -13 | 25 | 18 | 14 | 10 | 19 | 14 | 9 | 7 |
| 180 | 250 | 0 | -30 | 0 | -20 | 0 | -15 | 0 | -15 | 30 | 20 | 15 | 11 | 23 | 15 | 10 | 8 |
| 250 | 315 | 0 | -35 | 0 | -25 | 0 | -18 | 0 | -18 | 35 | 25 | 19 | 14 | 26 | 19 | 13 | 9 |
| 315 | 400 | 0 | -40 | 0 | -28 | 0 | -20 | 0 | -20 | 40 | 28 | 22 | 15 | 30 | 21 | 14 | 10 |
| 400 | 500 | 0 | -45 | 0 | -33 | 0 | -23 | 0 | -23 | 45 | – | – | – | 34 | – | – | – |
| 500 | 630 | 0 | -50 | 0 | -38 | 0 | -28 | 0 | -28 | 50 | – | – | – | 38 | – | – | – |
| 630 | 800 | 0 | -75 | 0 | -45 | – | – | – | – | – | – | – | – | – | – | – | – |
| 800 | 1 000 | 0 | -100 | 0 | -60 | – | – | – | – | – | – | – | – | – | – | – | – |

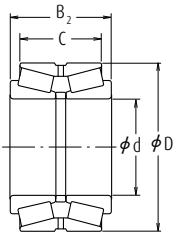
**Remarks**

1. The outside diameter "no-go side" tolerances (low) specified in this table do not necessarily apply within a distance of 1.2 times the chamfer dimension r (max.) from the ring face.
2. Some of these tolerances conform to the NSK Standard.

Units : µm

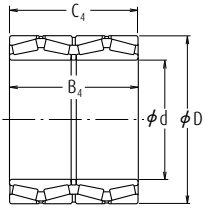
| | $K_{ia}$ | | | | $S_d$ | | $S_{ia}$ |
|---|---|---|---|---|---|---|---|
| | Normal Class 6X | Class 6 | Class 5 | Class 4 | Class 5 | Class 4 | Class 4 |
| | max. | max. | max. | max. | max. | max. | max. |
| | 15 | 7 | 3.5 | 2.5 | 7 | 3 | 3 |
| | 18 | 8 | 4 | 3 | 8 | 4 | 4 |
| | 20 | 10 | 5 | 4 | 8 | 4 | 4 |
| | 25 | 10 | 5 | 4 | 8 | 5 | 4 |
| | 30 | 13 | 6 | 5 | 9 | 5 | 5 |
| | 35 | 18 | 8 | 6 | 10 | 6 | 7 |
| | 50 | 20 | 10 | 8 | 11 | 7 | 8 |
| | 60 | 25 | 13 | 10 | 13 | 8 | 10 |
| | 70 | 30 | 15 | 12 | 15 | 10 | 14 |
| | 70 | 35 | 18 | 14 | 19 | 13 | 17 |
| | 85 | 40 | 20 | – | 22 | – | – |
| | 100 | 45 | 22 | – | 27 | – | – |




Units : µm

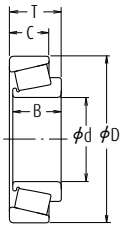
| | $K_{ea}$ | | | | $S_D$ | | $S_{ea}$ |
|---|---|---|---|---|---|---|---|
| | Normal Class 6X | Class 6 | Class 5 | Class 4 | Class 5 | Class 4 | Class 4 |
| | max. | max. | max. | max. | max. | max. | max. |
| | 18 | 9 | 6 | 4 | 8 | 4 | 5 |
| | 20 | 10 | 7 | 5 | 8 | 4 | 5 |
| | 25 | 13 | 8 | 5 | 8 | 4 | 5 |
| | 35 | 18 | 10 | 6 | 9 | 5 | 6 |
| | 40 | 20 | 11 | 7 | 10 | 5 | 7 |
| | 45 | 23 | 13 | 8 | 10 | 5 | 8 |
| | 50 | 25 | 15 | 10 | 11 | 7 | 10 |
| | 60 | 30 | 18 | 11 | 13 | 8 | 10 |
| | 70 | 35 | 20 | 13 | 13 | 10 | 13 |
| | 80 | 40 | 23 | 15 | 15 | 11 | 15 |
| | 100 | 50 | 25 | 18 | 18 | 13 | 18 |
| | 120 | 60 | 30 | – | 20 | – | – |
| | 120 | 75 | 35 | – | 23 | – | – |

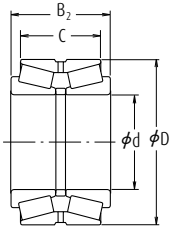


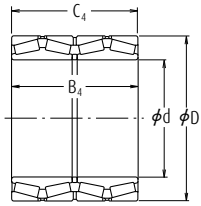
## Table 7.3 Tolerances for Metric Design Tapered Roller Bearings
## Table 7.3.3 Tolerances for Width, Overall Bearing Width, and Combined Bearing Width

| Nominal Bore Diameter d (mm) | | $\Delta_{Bs}$ | | | | | | $\Delta_{Cs}$ | | | | | | $\Delta_{Ts}$ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Normal Class 6 | | Class 6X | | Class 5 Class 4 | | Normal Class 6 | | Class 6X | | Class 5 Class 4 | | Normal Class 6 | | Class 6X | | Class 5 Class 4 | |
| over | incl. | high | low | high | low | high | low | high | low | high | low | high | low | high | low | high | low | high | low |
| 10 | 18 | 0 | -120 | 0 | -50 | 0 | -200 | 0 | -120 | 0 | -100 | 0 | -200 | +200 | 0 | +100 | 0 | +200 | -200 |
| 18 | 30 | 0 | -120 | 0 | -50 | 0 | -200 | 0 | -120 | 0 | -100 | 0 | -200 | +200 | 0 | +100 | 0 | +200 | -200 |
| 30 | 50 | 0 | -120 | 0 | -50 | 0 | -240 | 0 | -120 | 0 | -100 | 0 | -240 | +200 | 0 | +100 | 0 | +200 | -200 |
| 50 | 80 | 0 | -150 | 0 | -50 | 0 | -300 | 0 | -150 | 0 | -100 | 0 | -300 | +200 | 0 | +100 | 0 | +200 | -200 |
| 80 | 120 | 0 | -200 | 0 | -50 | 0 | -400 | 0 | -200 | 0 | -100 | 0 | -400 | +200 | -200 | +100 | 0 | +200 | -200 |
| 120 | 180 | 0 | -250 | 0 | -50 | 0 | -500 | 0 | -250 | 0 | -100 | 0 | -500 | +350 | -250 | +150 | 0 | +350 | -250 |
| 180 | 250 | 0 | -300 | 0 | -50 | 0 | -600 | 0 | -300 | 0 | -100 | 0 | -600 | +350 | -250 | +150 | 0 | +350 | -250 |
| 250 | 315 | 0 | -350 | 0 | -50 | 0 | -700 | 0 | -350 | 0 | -100 | 0 | -700 | +350 | -250 | +200 | 0 | +350 | -250 |
| 315 | 400 | 0 | -400 | 0 | -50 | 0 | -800 | 0 | -400 | 0 | -100 | 0 | -800 | +400 | -400 | +200 | 0 | +400 | -400 |
| 400 | 500 | 0 | -450 | – | – | 0 | -800 | 0 | -450 | – | – | 0 | -800 | +400 | -400 | – | – | +400 | -400 |
| 500 | 630 | 0 | -500 | – | – | 0 | -800 | 0 | -500 | – | – | 0 | -800 | +500 | -500 | – | – | +500 | -500 |
| 630 | 800 | 0 | -750 | – | – | 0 | -800 | 0 | -750 | – | – | 0 | -800 | +600 | -600 | – | – | +600 | -600 |

**Remarks** The effective width of an inner ring with rollers $T_1$ is defined as the overall bearing width of an inner ring with rollers combined with a master outer ring.
The effective width of an outer ring $T_2$ is defined as the overall bearing width of an outer ring combined with a master inner ring with rollers.



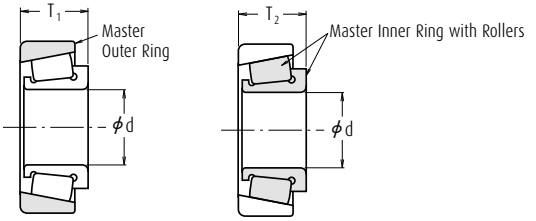



Units : µm

| Ring Width with Rollers $\Delta_{T1s}$ | | | | Outer Ring Effective Width Deviation $\Delta_{T2s}$ | | | | Overall Combined Bearing Width Deviation $\Delta_{B2s}$ | | $\Delta_{B4s}$ , $\Delta_{C4s}$ | | Nominal Bore Diameter d (mm) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Normal | | Class 6X | | Normal | | Class 6X | | All classes of double-row bearings | | All classes of four-row bearings | | | |
| high | low | high | low | high | low | high | low | high | low | high | low | over | incl. |
| +100 | 0 | +50 | 0 | +100 | 0 | +50 | 0 | +200 | -200 | – | – | **10** | **18** |
| +100 | 0 | +50 | 0 | +100 | 0 | +50 | 0 | +200 | -200 | – | – | **18** | **30** |
| +100 | 0 | +50 | 0 | +100 | 0 | +50 | 0 | +200 | -200 | – | – | **30** | **50** |
| +100 | 0 | +50 | 0 | +100 | 0 | +50 | 0 | +300 | -300 | +300 | -300 | **50** | **80** |
| +100 | -100 | +50 | 0 | +100 | -100 | +50 | 0 | +300 | -300 | +400 | -400 | **80** | **120** |
| +150 | -150 | +50 | 0 | +200 | -100 | +100 | 0 | +400 | -400 | +500 | -500 | **120** | **180** |
| +150 | -150 | +50 | 0 | +200 | -100 | +100 | 0 | +450 | -450 | +600 | -600 | **180** | **250** |
| +150 | -150 | +100 | 0 | +200 | -100 | +100 | 0 | +550 | -550 | +700 | -700 | **250** | **315** |
| +200 | -200 | +100 | 0 | +200 | -200 | +100 | 0 | +600 | -600 | +800 | -800 | **315** | **400** |
| – | – | – | – | – | – | – | – | +700 | -700 | +900 | -900 | **400** | **500** |
| – | – | – | – | – | – | – | – | +800 | -800 | +1 000 | -1 000 | **500** | **630** |
| – | – | – | – | – | – | – | – | +1 200 | -1 200 | +1 500 | -1 500 | **630** | **800** |





## Table 7.4 Tolerances for Inch Design Tapered Roller Bearings
(Refer to page A126 Table 7.1 for the tolerance class "CLASS ☆☆" that is the tolerance classes of ANSI/ABMA.)

### Table 7.4.1 Tolerances for Inner Ring Bore Diameter

Units : μm

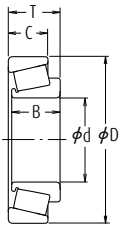
| Nominal Bore Diameter d | | | | $\Delta_{ds}$ | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| over | | incl. | | CLASS 4, 2 | | CLASS 3, 0 | | CLASS 00 | |
| (mm) | 1/25.4 | (mm) | 1/25.4 | high | low | high | low | high | low |
| – | – | **76.200** | 3.0000 | +13 | 0 | +13 | 0 | +8 | 0 |
| **76.200** | 3.0000 | **266.700** | 10.5000 | +25 | 0 | +13 | 0 | +8 | 0 |
| **266.700** | 10.5000 | **304.800** | 12.0000 | +25 | 0 | +13 | 0 | – | – |
| **304.800** | 12.0000 | **609.600** | 24.0000 | +51 | 0 | +25 | 0 | – | – |
| **609.600** | 24.0000 | **914.400** | 36.0000 | +76 | 0 | +38 | 0 | – | – |
| **914.400** | 36.0000 | **1 219.200** | 48.0000 | +102 | 0 | +51 | 0 | – | – |
| **1 219.200** | 48.0000 | – | – | +127 | 0 | +76 | 0 | – | – |

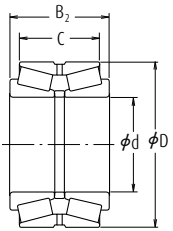
### Table 7.4.2 Tolerances for Outer Ring Outside Diameter and Radial Runout of Inner and Outer Rings

| Nominal Outside Diameter D | | | | $\Delta_{Ds}$ | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| over | | incl. | | CLASS 4, 2 | | CLASS 3, 0 | | CLASS 00 | |
| (mm) | 1/25.4 | (mm) | 1/25.4 | high | low | high | low | high | low |
| – | – | **266.700** | 10.5000 | +25 | 0 | +13 | 0 | +8 | 0 |
| **266.700** | 10.5000 | **304.800** | 12.0000 | +25 | 0 | +13 | 0 | +8 | 0 |
| **304.800** | 12.0000 | **609.600** | 24.0000 | +51 | 0 | +25 | 0 | – | – |
| **609.600** | 24.0000 | **914.400** | 36.0000 | +76 | 0 | +38 | 0 | – | – |
| **914.400** | 36.0000 | **1 219.200** | 48.0000 | +102 | 0 | +51 | 0 | – | – |
| **1 219.200** | 48.0000 | – | – | +127 | 0 | +76 | 0 | – | – |

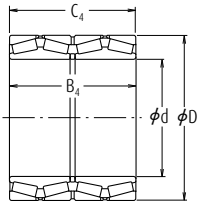
### Table 7.4.3 Tolerances for Overall Width and Combined Width

| Nominal Bore Diameter d | | | | $\Delta_{Ts}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| over | | incl. | | CLASS 4 | | CLASS 2 | | CLASS 3 | | | | CLASS 0, 00 | |
| | | | | | | | | D≤508.000 (mm) | | D＞508.000 (mm) | | | |
| (mm) | 1/25.4 | (mm) | 1/25.4 | high | low | high | low | high | low | high | low | high | low |
| – | – | **101.600** | 4.0000 | +203 | 0 | +203 | 0 | +203 | -203 | +203 | -203 | +203 | -203 |
| **101.600** | 4.0000 | **304.800** | 12.0000 | +356 | -254 | +203 | 0 | +203 | -203 | +203 | -203 | +203 | -203 |
| **304.800** | 12.0000 | **609.600** | 24.0000 | +381 | -381 | +381 | -381 | +203 | -203 | +381 | -381 | – | – |
| **609.600** | 24.0000 | – | – | +381 | -381 | – | – | +381 | -381 | +381 | -381 | – | – |




KBE




KV

Units : µm

| $K_{ia}$, $K_{ea}$ | | | | |
|---|---|---|---|---|
| CLASS 4 | CLASS 2 | CLASS 3 | CLASS 0 | CLASS 00 |
| max. | max. | max. | max. | max. |
| 51 | 38 | 8 | 4 | 2 |
| 51 | 38 | 8 | 4 | 2 |
| 51 | 38 | 18 | – | – |
| 76 | 51 | 51 | – | – |
| 76 | – | 76 | – | – |
| 76 | – | 76 | – | – |

Units : µm

| Double-Row Bearings (KBE Type) $\Delta_{B2s}$ | | | | | | | | | | Four-Row Bearings (KV Type) $\Delta_{B4s}$, $\Delta_{C4s}$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CLASS 4 | | CLASS 2 | | CLASS 3 | | | | CLASS 0, 00 | | CLASS 4, 3 | |
| | | | | D≤508.000 (mm) | | D＞508.000 (mm) | | | | | |
| high | low | high | low | high | low | high | low | high | low | high | low |
| +406 | 0 | +406 | 0 | +406 | -406 | +406 | -406 | +406 | -406 | +1 524 | -1 524 |
| +711 | -508 | +406 | -203 | +406 | -406 | +406 | -406 | +406 | -406 | +1 524 | -1 524 |
| +762 | -762 | +762 | -762 | +406 | -406 | +762 | -762 | – | – | +1 524 | -1 524 |
| +762 | -762 | – | – | +762 | -762 | +762 | -762 | – | – | +1 524 | -1 524 |

## Table 7.5 Tolerances for Magneto Bearings
## Table 7.5.1 Tolerances for Inner Rings and Width of Outer Rings

| Nominal Bore Diameter d (mm) | | $\Delta_{dmp}$ | | | | | | $V_{dp}$ | | | $V_{dmp}$ | | | $\Delta_{Bs}$ (or $\Delta_{Cs}$) (1) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Normal | | Class 6 | | Class 5 | | Normal | Class 6 | Class 5 | Normal | Class 6 | Class 5 | Normal Class 6 | | Class 5 | |
| over | incl. | high | low | high | low | high | low | max. | max. | max. | max. | max. | max. | high | low | high | low |
| 2.5 | 10 | 0 | -8 | 0 | -7 | 0 | -5 | 6 | 5 | 4 | 6 | 5 | 3 | 0 | -120 | 0 | -40 |
| 10 | 18 | 0 | -8 | 0 | -7 | 0 | -5 | 6 | 5 | 4 | 6 | 5 | 3 | 0 | -120 | 0 | -80 |
| 18 | 30 | 0 | -10 | 0 | -8 | 0 | -6 | 8 | 6 | 5 | 8 | 6 | 3 | 0 | -120 | 0 | -120 |

**Note** (1) The width deviation and width variation of an outer ring is determined according to the inner ring of the same bearing.

**Remarks** The bore diameter "no-go side" tolerances (high) specified in this table do not necessarily apply within a distance of 1.2 times the chamfer dimension r (max.) from the ring face.

## Table 7.5.2 Tolerances for Outer Rings

| Nominal Outside Diameter D (mm) | | $\Delta_{Dmp}$ | | | | | | | | | | | | $V_{Dp}$ | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Bearing Series E | | | | | | Bearing Series EN | | | | | | | | |
| | | Normal | | Class 6 | | Class 5 | | Normal | | Class 6 | | Class 5 | | Normal | Class 6 | Class 5 |
| over | incl. | high | low | high | low | high | low | high | low | high | low | high | low | max. | max. | max. |
| 6 | 18 | +8 | 0 | +7 | 0 | +5 | 0 | 0 | -8 | 0 | -7 | 0 | -5 | 6 | 5 | 4 |
| 18 | 30 | +9 | 0 | +8 | 0 | +6 | 0 | 0 | -9 | 0 | -8 | 0 | -6 | 7 | 6 | 5 |
| 30 | 50 | +11 | 0 | +9 | 0 | +7 | 0 | 0 | -11 | 0 | -9 | 0 | -7 | 8 | 7 | 5 |

**Remarks** The outside diameter "no-go side" tolerances (low) do not necessarily apply within a distance of 1.2 times the chamfer dimension r (max.) from the ring face.

Units : µm

| | $V_{Bs}$ (or $V_{Cs}$) (1) | | $\Delta_{Ts}$ | | $K_{ia}$ | | | $S_d$ | $S_{ia}$ |
|---|---|---|---|---|---|---|---|---|---|
| | Normal Class 6 | Class 5 | Normal Class 6 Class 5 | | Normal | Class 6 | Class 5 | Class 5 | Class 5 |
| | max. | max. | high | low | max. | max. | max. | max. | max. |
| | 15 | 5 | +120 | -120 | 10 | 6 | 4 | 7 | 7 |
| | 20 | 5 | +120 | -120 | 10 | 7 | 4 | 7 | 7 |
| | 20 | 5 | +120 | -120 | 13 | 8 | 4 | 8 | 8 |

Units : µm

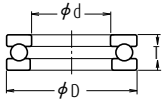
| | $V_{Dmp}$ | | | $K_{ea}$ | | | $S_{ea}$ | $S_D$ |
|---|---|---|---|---|---|---|---|---|
| | Normal | Class 6 | Class 5 | Normal | Class 6 | Class 5 | Class 5 | Class 5 |
| | max. | max. | max. | max. | max. | max. | max. | max. |
| | 6 | 5 | 3 | 15 | 8 | 5 | 8 | 8 |
| | 7 | 6 | 3 | 15 | 9 | 6 | 8 | 8 |
| | 8 | 7 | 4 | 20 | 10 | 7 | 8 | 8 |

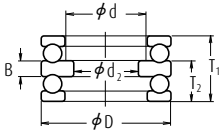
## Table 7.6 Tolerances for Thrust Ball Bearings
## Table 7.6.1 Tolerances for Shaft Washer Bore Diameter and Running Accuracy

Units : µm

| Nominal Bore Diameter d or $d_2$ (mm) | | $\Delta_{dmp}$ or $\Delta_{d2mp}$ | | | | $V_{dp}$ or $V_{d2p}$ | | $S_i$ or $S_e$ (1) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Normal Class 6 Class 5 | | Class 4 | | Normal Class 6 Class 5 | Class 4 | Normal | Class 6 | Class 5 | Class 4 |
| over | incl. | high | low | high | low | max. | 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 |
| 630 | 800 | 0 | -75 | 0 | -50 | – | – | 40 | 25 | 13 | 8 |
| 800 | 1 000 | 0 | -100 | – | – | – | – | 45 | 30 | 15 | – |
| 1 000 | 1 250 | 0 | -125 | – | – | – | – | 50 | 35 | 18 | – |

**Note** (1) For double-direction bearings, the thickness variation does not depend on the bore diameter $d_2$, but on d for single-direction bearings with the same D in the same diameter series.
The thickness variation of housing washers, $S_e$, applies only to flat-seat thrust bearings.

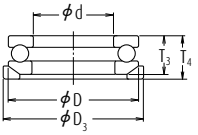


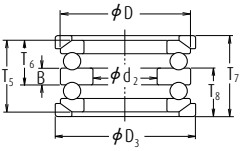



## Table 7.6.2 Tolerances for Outside Diameter of Housing Washers and Aligning Seat Washers

Units : µm

| Nominal Outside Diameter of Bearing or Aligning Seat Washer D or $D_3$ (mm) | | $\Delta_{Dmp}$ | | | | | | $V_{Dp}$ | | Aligning Seat Washer Outside Diameter Deviation $\Delta_{D\,3s}$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Flat Seat Type | | | | Aligning Seat Washer Type | | | | | |
| | | Normal Class 6 Class 5 | | Class 4 | | Normal Class 6 | | Normal Class 6 Class 5 | Class 4 | Normal Class 6 | |
| over | incl. | high | low | high | low | high | low | max. | max. | high | low |
| 10 | 18 | 0 | -11 | 0 | -7 | 0 | -17 | 8 | 5 | 0 | -25 |
| 18 | 30 | 0 | -13 | 0 | -8 | 0 | -20 | 10 | 6 | 0 | -30 |
| 30 | 50 | 0 | -16 | 0 | -9 | 0 | -24 | 12 | 7 | 0 | -35 |
| 50 | 80 | 0 | -19 | 0 | -11 | 0 | -29 | 14 | 8 | 0 | -45 |
| 80 | 120 | 0 | -22 | 0 | -13 | 0 | -33 | 17 | 10 | 0 | -60 |
| 120 | 180 | 0 | -25 | 0 | -15 | 0 | -38 | 19 | 11 | 0 | -75 |
| 180 | 250 | 0 | -30 | 0 | -20 | 0 | -45 | 23 | 15 | 0 | -90 |
| 250 | 315 | 0 | -35 | 0 | -25 | 0 | -53 | 26 | 19 | 0 | -105 |
| 315 | 400 | 0 | -40 | 0 | -28 | 0 | -60 | 30 | 21 | 0 | -120 |
| 400 | 500 | 0 | -45 | 0 | -33 | 0 | -68 | 34 | 25 | 0 | -135 |
| 500 | 630 | 0 | -50 | 0 | -38 | 0 | -75 | 38 | 29 | 0 | -180 |
| 630 | 800 | 0 | -75 | 0 | -45 | 0 | -113 | 55 | 34 | 0 | -225 |
| 800 | 1 000 | 0 | -100 | – | – | – | – | 75 | – | – | – |
| 1 000 | 1 250 | 0 | -125 | – | – | – | – | – | – | – | – |
| 1 250 | 1 600 | 0 | -160 | – | – | – | – | – | – | – | – |



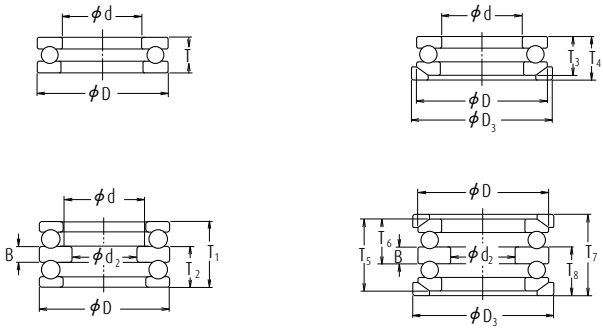
## Table 7.6.3 Tolerances for Thrust Ball Bearing Height and Central Washer Height

Units : μm

| Nominal Bore Diameter d(1) (mm) | | Flat Seat Type | | | | Aligning Seat Washer Type | | | | With Aligning Seat Washer | | | | Height Deviation of Central Washer | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $\Delta_{Ts}$ or $\Delta_{T2s}$ | | $\Delta_{T1s}$ | | $\Delta_{T3s}$ or $\Delta_{T6s}$ | | $\Delta_{T5s}$ | | $\Delta_{T4s}$ or $\Delta_{T8s}$ | | $\Delta_{T7s}$ | | $\Delta_{Bs}$ | |
| | | Normal, Class 6 Class 5, Class 4 | | Normal, Class 6 Class 5, Class 4 | | Normal Class 6 | | Normal Class 6 | | Normal Class 6 | | Normal Class 6 | | Normal, Class 6 Class 5, Class 4 | |
| over | incl. | high | low | high | low | high | low | high | low | high | low | high | low | high | low |
| – | 30 | 0 | -75 | +50 | -150 | 0 | -75 | +50 | -150 | +50 | -75 | +150 | -150 | 0 | -50 |
| 30 | 50 | 0 | -100 | +75 | -200 | 0 | -100 | + 75 | -200 | +50 | -100 | +175 | -200 | 0 | -75 |
| 50 | 80 | 0 | -125 | +100 | -250 | 0 | -125 | +100 | -250 | +75 | -125 | +250 | -250 | 0 | -100 |
| 80 | 120 | 0 | -150 | +125 | -300 | 0 | -150 | +125 | -300 | +75 | -150 | +275 | -300 | 0 | -125 |
| 120 | 180 | 0 | -175 | +150 | -350 | 0 | -175 | +150 | -350 | +100 | -175 | +350 | -350 | 0 | -150 |
| 180 | 250 | 0 | -200 | +175 | -400 | 0 | -200 | +175 | -400 | +100 | -200 | +375 | -400 | 0 | -175 |
| 250 | 315 | 0 | -225 | +200 | -450 | 0 | -225 | +200 | -450 | +125 | -225 | +450 | -450 | 0 | -200 |
| 315 | 400 | 0 | -300 | +250 | -600 | 0 | -300 | +250 | -600 | +150 | -275 | +550 | -550 | 0 | -250 |

**Note** (1) For double-direction bearings, its classification depends on d for single-direction bearings with the same D in the same diameter series.

**Remarks** $\Delta_{Ts}$ in the table is the deviation in the respective heights T in figures below.



## Table 7.7 Tolerances for Tapered Roller Thrust Bearings

### Table 7.7.1 Tolerances for Bore Diameters of Shaft Washers and Height (Metric, Class Normal)

Units : µm

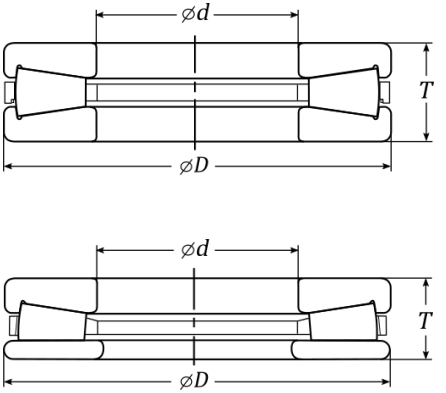
| Nominal Bore Diameter d (mm) | | $\Delta_{dmp}$ | | $\Delta_{Ts}$ | |
|---|---|---|---|---|---|
| over | incl. | high | low | high | low |
| 80 | 120 | 0 | -20 | 0 | -150 |
| 120 | 180 | 0 | -25 | 0 | -175 |
| 180 | 250 | 0 | -30 | 0 | -200 |
| 250 | 315 | 0 | -35 | 0 | -225 |
| 315 | 400 | 0 | -40 | 0 | -300 |
| 400 | 500 | 0 | -45 | 0 | -350 |
| 500 | 630 | 0 | -50 | 0 | -450 |
| 630 | 800 | 0 | -75 | 0 | -550 |
| 800 | 1 000 | 0 | -100 | 0 | -700 |
| 1 000 | 1 250 | 0 | -125 | 0 | -900 |
| 1 250 | 1 600 | 0 | -160 | 0 | -1 200 |

### Table 7.7.2 Tolerances for Housing Washer Outside Diameters (Metric, Class Normal)

Units : µm

| Nominal Outside Diameter D (mm) | | $\Delta_{Dmp}$ | |
|---|---|---|---|
| over | incl. | high | low |
| 180 | 250 | 0 | -30 |
| 250 | 315 | 0 | -35 |
| 315 | 400 | 0 | -40 |
| 400 | 500 | 0 | -45 |
| 500 | 630 | 0 | -50 |
| 630 | 800 | 0 | -75 |
| 800 | 1 000 | 0 | -100 |
| 1 000 | 1 250 | 0 | -125 |
| 1 250 | 1 600 | 0 | -160 |
| 1 600 | 2 000 | 0 | -200 |





## Table 7.7 Tolerances for Tapered Roller Thrust Bearings

### Table 7.7.3 Tolerances for Bore Diameters of Shaft Washers and Height (Inch, Class 4)

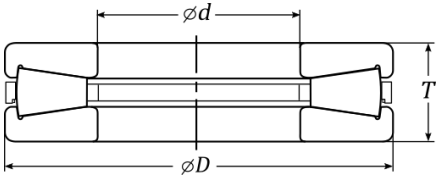
Units : µm

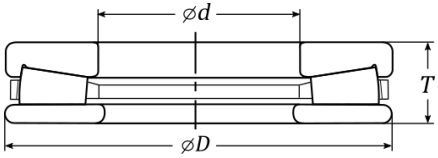
| Nominal Bore Diameter d (mm) | | | | $\Delta_{dmp}$ | | $\Delta_{Ts}$ | |
|---|---|---|---|---|---|---|---|
| over | | incl. | | | | | |
| (mm) | (inch) | (mm) | (inch) | high | low | high | low |
| — | — | **304.800** | 12.0000 | +25 | 0 | +381 | -381 |
| **304.800** | 12.0000 | **609.600** | 24.0000 | +51 | 0 | +381 | -381 |
| **609.600** | 24.0000 | **914.400** | 36.0000 | +76 | 0 | +381 | -381 |
| **914.400** | 36.0000 | **1 219.200** | 48.0000 | +102 | 0 | +381 | -381 |

### Table 7.7.4 Tolerances for Bore Diameters of Shaft Washers and Height (Inch, Class 4)

Units : µm

| Nominal Outside Diameter D (mm) | | | | $\Delta_{Dmp}$ | |
|---|---|---|---|---|---|
| over | | incl. | | | |
| (mm) | (inch) | (mm) | (inch) | high | low |
| — | — | **304.800** | 12.0000 | +25 | 0 |
| **304.800** | 12.0000 | **609.600** | 24.0000 | +51 | 0 |
| **609.600** | 24.0000 | **914.400** | 36.0000 | +76 | 0 |
| **914.400** | 36.0000 | **1 219.200** | 48.0000 | +102 | 0 |
| **1 219.200** | 48.0000 | — | — | +127 | 0 |



## Table 7.8 Tolerances for Thrust Spherical Roller Bearings
## Table 7.8.1 Tolerances for Bore Diameters of Shaft Rings and Height (Class Normal)

Units : µm

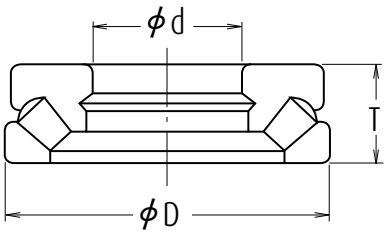
| Nominal Bore Diameter d (mm) | | $\Delta_{dmp}$ | | $V_{dp}$ | Reference | | |
|---|---|---|---|---|---|---|---|
| | | | | | $S_d$ | $\Delta_{Ts}$ | |
| over | incl. | high | low | max. | max. | high | low |
| 50 | 80 | 0 | -15 | 11 | 25 | +150 | -150 |
| 80 | 120 | 0 | -20 | 15 | 25 | +200 | -200 |
| 120 | 180 | 0 | -25 | 19 | 30 | +250 | -250 |
| 180 | 250 | 0 | -30 | 23 | 30 | +300 | -300 |
| 250 | 315 | 0 | -35 | 26 | 35 | +350 | -350 |
| 315 | 400 | 0 | -40 | 30 | 40 | +400 | -400 |
| 400 | 500 | 0 | -45 | 34 | 45 | +450 | -450 |

**Remarks** The bore diameter "no-go side" tolerances (high) specified in this table do not necessarily apply within a distance of 1.2 times the chamfer dimension r (max.) from the ring face.

## Table 7.8.2 Tolerances for Housing Ring Diameter (Class Normal)

Units : µm

| Nominal Outside Diameter D (mm) | | $\Delta_{Dmp}$ | |
|---|---|---|---|
| over | incl. | high | low |
| 120 | 180 | 0 | -25 |
| 180 | 250 | 0 | -30 |
| 250 | 315 | 0 | -35 |
| 315 | 400 | 0 | -40 |
| 400 | 500 | 0 | -45 |
| 500 | 630 | 0 | -50 |
| 630 | 800 | 0 | -75 |
| 800 | 1 000 | 0 | -100 |




**Remarks** The outside diameter "no-go side" tolerances (low) specified in this table do not necessarily apply within a distance of 1.2 times the chamfer dimension r (max.) from the ring face.

## Table 7.9 Tolerances of Instrument Ball Bearings (Inch design) CLASS 5P, CLASS 7P, and CLASS 9P (ANSI/ABMA Equivalent)

### (1) Tolerances for Inner Rings and Width of Outer Rings

| Nominal Bore Diameter d (mm) | | $\Delta_{dmp}$ | | | | $\Delta_{ds}$ | | | | $V_{dp}$ | | $V_{dmp}$ | | $\Delta_{Bs}$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CLASS 5P CLASS 7P | | CLASS 9P | | CLASS 5P CLASS 7P | | CLASS 9P | | CLASS 5P CLASS 7P | CLASS 9P | CLASS 5P CLASS 7P | CLASS 9P | Single Brgs. | |
| | | | | | | | | | | | | | | CLASS 5P CLASS 7P CLASS 9P | |
| over | incl. | high | low | high | low | high | low | high | low | max. | max. | max. | max. | high | low |
| – | 10 | 0 | -5.1 | 0 | -2.5 | 0 | -5.1 | 0 | -2.5 | 2.5 | 1.3 | 2.5 | 1.3 | 0 | -25.4 |
| 10 | 18 | 0 | -5.1 | 0 | -2.5 | 0 | -5.1 | 0 | -2.5 | 2.5 | 1.3 | 2.5 | 1.3 | 0 | -25.4 |
| 18 | 30 | 0 | -5.1 | 0 | -2.5 | 0 | -5.1 | 0 | -2.5 | 2.5 | 1.3 | 2.5 | 1.3 | 0 | -25.4 |

**Note** (1) Applicable to bearings for which the axial clearance (preload) is to be adjusted by combining two selected bearings.

**Remarks** For the CLASS 3P and the tolerances of Metric design Instrument Ball Bearings, it is advisable to consult NSK.

### (2) Tolerances for Outer Rings

| Nominal Outside Diameter D (mm) | | $\Delta_{Dmp}$ | | | | $\Delta_{Ds}$ | | | | | | $V_{Dp}$ | | | $V_{Dmp}$ | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CLASS 5P CLASS 7P | | CLASS 9P | | CLASS 5P CLASS 7P | | | | CLASS 9P | | CLASS 5P CLASS 7P | | CLASS 9P | CLASS 5P CLASS 7P | | CLASS 9P |
| | | | | | | Open | | Shielded Sealed | | Open | | Open | Shielded Sealed | Open | Open | Shielded Sealed | Open |
| over | incl. | high | low | high | low | high | low | high | low | high | low | max. | max. | max. | max. | max. | max. |
| – | 18 | 0 | -5.1 | 0 | -2.5 | 0 | -5.1 | +1 | -6.1 | 0 | -2.5 | 2.5 | 5.1 | 1.3 | 2.5 | 5.1 | 1.3 |
| 18 | 30 | 0 | -5.1 | 0 | -3.8 | 0 | -5.1 | +1 | -6.1 | 0 | -3.8 | 2.5 | 5.1 | 2 | 2.5 | 5.1 | 2 |
| 30 | 50 | 0 | -5.1 | 0 | -3.8 | 0 | -5.1 | +1 | -6.1 | 0 | -3.8 | 2.5 | 5.1 | 2 | 2.5 | 5.1 | 2 |

**Notes** (1) Applicable to flange width variation for flanged bearings.
(2) Applicable to flange back face.

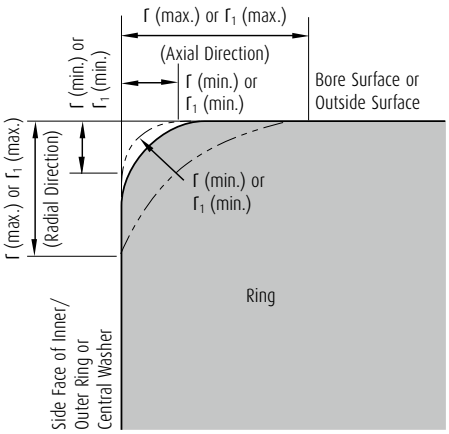
Units : µm

| (or $\Delta_{Cs}$) | | $V_{Bs}$ | | | $K_{ia}$ | | | $S_{ia}$ | | | $S_d$ | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Combined Brgs.(1) | | | | | | | | | | | | | |
| CLASS 5P CLASS 7P CLASS 9P | | CLASS 5P | CLASS 7P | CLASS 9P | CLASS 5P | CLASS 7P | CLASS 9P | CLASS 5P | CLASS 7P | CLASS9P | CLASS 5P | CLASS 7P | CLASS 9P |
| high | low | max. | max. | max. | max. | max. | max. | max. | max. | max. | max. | max. | max. |
| 0 | -400 | 5.1 | 2.5 | 1.3 | 3.8 | 2.5 | 1.3 | 7.6 | 2.5 | 1.3 | 7.6 | 2.5 | 1.3 |
| 0 | -400 | 5.1 | 2.5 | 1.3 | 3.8 | 2.5 | 1.3 | 7.6 | 2.5 | 1.3 | 7.6 | 2.5 | 1.3 |
| 0 | -400 | 5.1 | 2.5 | 1.3 | 3.8 | 3.8 | 2.5 | 7.6 | 3.8 | 1.3 | 7.6 | 3.8 | 1.3 |

Units : µm

| $V_{Cs}$ (1) | | | $S_D$ | | | $K_{ea}$ | | | $S_{ea}$ | | | Deviation of Flange Outside Diameter $\Delta_{D1s}$ | | Deviation of Flange Width $\Delta_{C1s}$ | | Flange Backface Runout with Raceway (2) $S_{ea1}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CLASS 5P | CLASS 7P | CLASS 9P | CLASS 5P | CLASS 7P | CLASS 9P | CLASS 5P | CLASS 7P | CLASS 9P | CLASS 5P | CLASS 7P | CLASS 9P | CLASS 5P CLASS 7P | | CLASS 5P CLASS 7P | | CLASS 5P CLASS 7P |
| max. | max. | max. | max. | max. | max. | max. | max. | max. | max. | max. | max. | high | low | high | low | max. |
| 5.1 | 2.5 | 1.3 | 7.6 | 3.8 | 1.3 | 5.1 | 3.8 | 1.3 | 7.6 | 5.1 | 1.3 | 0 | -25.4 | 0 | -50.8 | 7.6 |
| 5.1 | 2.5 | 1.3 | 7.6 | 3.8 | 1.3 | 5.1 | 3.8 | 2.5 | 7.6 | 5.1 | 2.5 | 0 | -25.4 | 0 | -50.8 | 7.6 |
| 5.1 | 2.5 | 1.3 | 7.6 | 3.8 | 1.3 | 5.1 | 5.1 | 2.5 | 7.6 | 5.1 | 2.5 | 0 | -25.4 | 0 | -50.8 | 7.6 |

## Table 7.10 Chamfer Dimension Limits (for Metric Design Bearings)
## Table 7.10.1 Chamfer Dimension Limits for Radial Bearings (excluding Tapered Roller Bearings)




r : Chamfer Dimension of Inner/Outer Ring

$r_1$ : Chamfer Dimension of Inner/Outer Ring (Front Side) or of Central Washer of Thrust Ball Bearings

**Remarks** The precise shape of chamfer surfaces has not been specified but its profile in the axial plane shall not intersect an arc of radius r (min.) or $r_1$ (min.) touching the side face of an inner ring or central washer and bore surface, or the side face of an outer ring and outside surface.

Units : mm

| Permissible Chamfer Dimension for Inner/ Outer Rings r (min.) or $r_1$ (min.) | Nominal Bore Diameter d | | Permissible Chamfer Dimension for Inner/Outer Rings r (max.) or $r_1$ (max.) | | Reference |
|---|---|---|---|---|---|
| | | | | | Corner Radius of Shaft or Housing $r_a$ |
| | over | incl. | Radial Direction | Axial Direction | max. |
| 0.05 | – | – | 0.1 | 0.2 | 0.05 |
| 0.08 | – | – | 0.16 | 0.3 | 0.08 |
| 0.1 | – | – | 0.2 | 0.4 | 0.1 |
| 0.15 | – | – | 0.3 | 0.6 | 0.15 |
| 0.2 | – | – | 0.5 | 0.8 | 0.2 |
| 0.3 | – | 40 | 0.6 | 1 | 0.3 |
| | 40 | – | 0.8 | 1 | |
| 0.6 | – | 40 | 1 | 2 | 0.6 |
| | 40 | – | 1.3 | 2 | |
| 1 | – | 50 | 1.5 | 3 | 1 |
| | 50 | | 1.9 | 3 | |
| 1.1 | – | 120 | 2 | 3.5 | 1 |
| | 120 | – | 2.5 | 4 | |
| 1.5 | – | 120 | 2.3 | 4 | 1.5 |
| | 120 | – | 3 | 5 | |
| 2 | – | 80 | 3 | 4.5 | 2 |
| | 80 | 220 | 3.5 | 5 | |
| | 220 | – | 3.8 | 6 | |
| 2.1 | – | 280 | 4 | 6.5 | 2 |
| | 280 | – | 4.5 | 7 | |
| 2.5 | – | 100 | 3.8 | 6 | 2 |
| | 100 | 280 | 4.5 | 6 | |
| | 280 | – | 5 | 7 | |
| 3 | – | 280 | 5 | 8 | 2.5 |
| | 280 | – | 5.5 | 8 | |
| 4 | – | – | 6.5 | 9 | 3 |
| 5 | – | – | 8 | 10 | 4 |
| 6 | – | – | 10 | 13 | 5 |
| 7.5 | – | – | 12.5 | 17 | 6 |
| 9.5 | – | – | 15 | 19 | 8 |
| 12 | – | – | 18 | 24 | 10 |
| 15 | – | – | 21 | 30 | 12 |
| 19 | – | – | 25 | 38 | 15 |

**Remarks** For bearings with nominal widths less than 2 mm, the value of r (max.) in the axial direction is the same as that in the radial direction.

## Table 7.10.2 Chamfer Dimension Limits for Tapered Roller Bearings

Units : mm

| Permissible Chamfer Dimension for Inner/Outer Rings r (min.) | Nominal Bore or Nominal Outside Diameter (1) d or D | | Permissible Chamfer Dimension for Inner/Outer Rings r (max.) | | Reference |
|---|---|---|---|---|---|
| | | | | | Corner Radius of Shaft or Housing $r_a$ |
| | over | incl. | Radial Direction | Axial Direction | max. |
| 0.15 | – | – | 0.3 | 0.6 | 0.15 |
| 0.3 | – | 40 | 0.7 | 1.4 | 0.3 |
| | 40 | – | 0.9 | 1.6 | |
| 0.6 | – | 40 | 1.1 | 1.7 | 0.6 |
| | 40 | – | 1.3 | 2 | |
| 1 | – | 50 | 1.6 | 2.5 | 1 |
| | 50 | – | 1.9 | 3 | |
| 1.5 | – | 120 | 2.3 | 3 | 1.5 |
| | 120 | 250 | 2.8 | 3.5 | |
| | 250 | – | 3.5 | 4 | |
| 2 | – | 120 | 2.8 | 4 | 2 |
| | 120 | 250 | 3.5 | 4.5 | |
| | 250 | – | 4 | 5 | |
| 2.5 | – | 120 | 3.5 | 5 | 2 |
| | 120 | 250 | 4 | 5.5 | |
| | 250 | – | 4.5 | 6 | |
| 3 | – | 120 | 4 | 5.5 | 2.5 |
| | 120 | 250 | 4.5 | 6.5 | |
| | 250 | 400 | 5 | 7 | |
| | 400 | – | 5.5 | 7.5 | |
| 4 | – | 120 | 5 | 7 | 3 |
| | 120 | 250 | 5.5 | 7.5 | |
| | 250 | 400 | 6 | 8 | |
| | 400 | – | 6.5 | 8.5 | |
| 5 | – | 180 | 6.5 | 8 | 4 |
| | 180 | – | 7.5 | 9 | |
| 6 | – | 180 | 7.5 | 10 | 5 |
| | 180 | – | 9 | 11 | |

Note (1) Inner Rings are classified by d and Outer Rings by D.

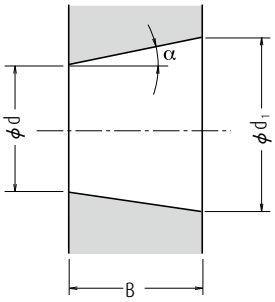
## Table 7.10.3 Chamfer Dimension Limits for Thrust Bearings

Units : mm

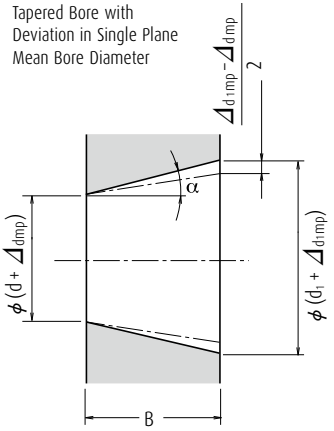
| Permissible Chamfer Dimension for Shaft (or Central)/ Housing Washers r (min.) or $r_1$ (min.) | Permissible Chamfer Dimension for Shaft (or Central)/Housing Washers r (max.) or $r_1$ (max.) | Reference |
|---|---|---|
| | | Corner Radius of Shaft or Housing $r_a$ |
| | Radial and Axial Direction | max. |
| 0.05 | 0.1 | 0.05 |
| 0.08 | 0.16 | 0.08 |
| 0.1 | 0.2 | 0.1 |
| 0.15 | 0.3 | 0.15 |
| 0.2 | 0.5 | 0.2 |
| 0.3 | 0.8 | 0.3 |
| 0.6 | 1.5 | 0.6 |
| 1 | 2.2 | 1 |
| 1.1 | 2.7 | 1 |
| 1.5 | 3.5 | 1.5 |
| 2 | 4 | 2 |
| 2.1 | 4.5 | 2 |
| 3 | 5.5 | 2.5 |
| 4 | 6.5 | 3 |
| 5 | 8 | 4 |
| 6 | 10 | 5 |
| 7.5 | 12.5 | 6 |
| 9.5 | 15 | 8 |
| 12 | 18 | 10 |
| 15 | 21 | 12 |
| 19 | 25 | 15 |

## Table 7.11 Tolerances for Tapered Bores (Class Normal)

Nominal Tapered Bore




Tapered Bore with Deviation in Single Plane Mean Bore Diameter




d : Nominal Bore Diameter

$d_1$ : Theoretical Diameter of Larger End of Tapered Bore

Taper 1:12 $d_1 = d + 1/12\ B$ Taper 1:30 $d_1 = d + /30\ B$

$\Delta_{dmp}$ : Single Plane Mean Bore Diameter Deviation in Theoretical Diameter of Smaller End of Bore

$\Delta_{d1mp}$ : Single Plane Mean Bore Diameter Deviation in Theoretical Diameter of Larger End of Bore

$V_{dp}$ : Bore diameter variation in a single radial plane

B : Nominal Inner Ring width

α : Half of Taper Angle of Tapered Bore

Taper 1:12
α = 2°23′9.4
= 2.38594°
= 0.041643 rad

Taper 1:30
α = 57′17.4
= 0.95484°
= 0.016665 rad

### Taper 1 : 12

Units : µm

| Nominal Bore Diameter d (mm) | | $\Delta_{dmp}$ | | $\Delta_{d1mp} - \Delta_{dmp}$ | | $V_{dp}$ (1)(2) |
|---|---|---|---|---|---|---|
| over | incl. | high | low | high | low | max. |
| 18 | 30 | +33 | 0 | +21 | 0 | 13 |
| 30 | 50 | +39 | 0 | +25 | 0 | 16 |
| 50 | 80 | +46 | 0 | +30 | 0 | 19 |
| 80 | 120 | +54 | 0 | +35 | 0 | 22 |
| 120 | 180 | +63 | 0 | +40 | 0 | 40 |
| 180 | 250 | +72 | 0 | +46 | 0 | 46 |
| 250 | 315 | +81 | 0 | +52 | 0 | 52 |
| 315 | 400 | +89 | 0 | +57 | 0 | 57 |
| 400 | 500 | +97 | 0 | +63 | 0 | 63 |
| 500 | 630 | +110 | 0 | +70 | 0 | 70 |
| 630 | 800 | +125 | 0 | +80 | 0 | – |
| 800 | 1 000 | +140 | 0 | +90 | 0 | – |
| 1 000 | 1 250 | +165 | 0 | +105 | 0 | – |
| 1 250 | 1 600 | +195 | 0 | +125 | 0 | – |

**Notes** (1) Applicable to all radial planes of tapered bores.
(2) Not applicable to diameter series 7 and 8.

### Taper 1 : 30

Units : µm

| Nominal Bore Diameter d (mm) | | $\Delta_{dmp}$ | | $\Delta_{d1mp} - \Delta_{dmp}$ | | $V_{dp}$ (1)(2) |
|---|---|---|---|---|---|---|
| over | incl. | high | low | high | low | max. |
| 80 | 120 | +20 | 0 | +35 | 0 | 22 |
| 120 | 180 | +25 | 0 | +40 | 0 | 40 |
| 180 | 250 | +30 | 0 | +46 | 0 | 46 |
| 250 | 315 | +35 | 0 | +52 | 0 | 52 |
| 315 | 400 | +40 | 0 | +57 | 0 | 57 |
| 400 | 500 | +45 | 0 | +63 | 0 | 63 |
| 500 | 630 | +50 | 0 | +70 | 0 | 70 |

**Notes** (1) Applicable to all radial planes of tapered bores.
(2) Not applicable to diameter series 7 and 8.

**Remarks** For values exceeding 630 mm, please contact NSK.

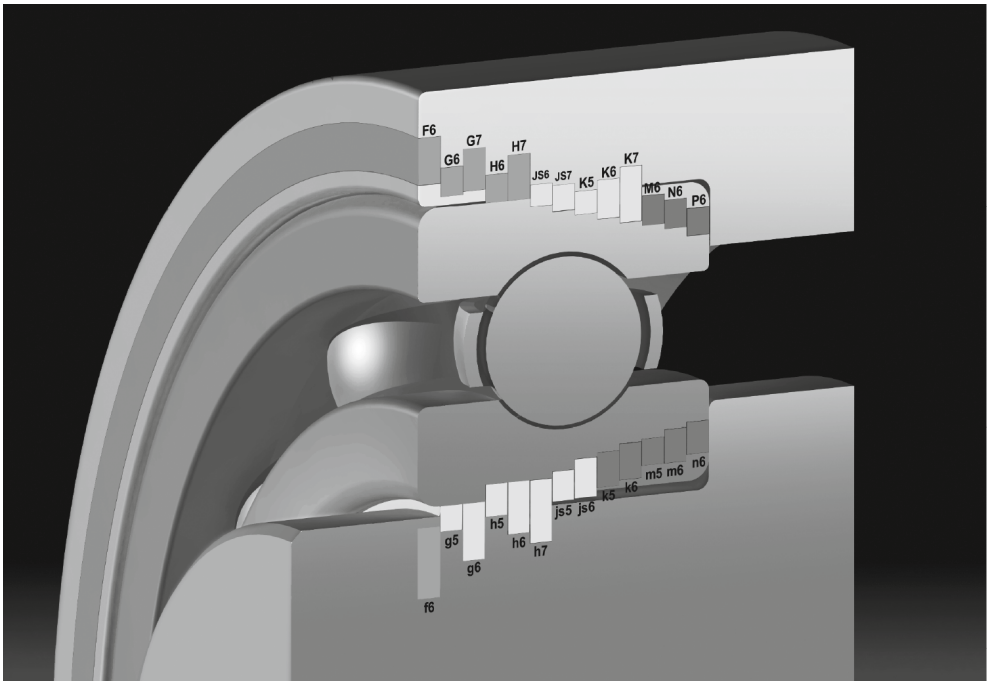
## 7.2 Selection of Accuracy Classes

For general applications, Class Normal tolerances are adequate in nearly all cases for satisfactory performance, but for the following applications, bearings having an accuracy class of 5,4 or higher are more suitable.

For reference, in Table 7.11, examples of applications and appropriate tolerance classes are listed for various bearing requirements and operating conditions.

### Table 7.12 Typical Tolerance Classes for Specific Applications (Reference)

| Bearing Requirement, Operating Conditions | Examples of Applications | Tolerance Classes |
|---|---|---|
| **High running accuracy is required** | VTR Drum Spindles | P5 |
| | Magnetic Disk Spindles for Computers | P5, P4, P2 |
| | Machine-Tool Main Spindles | P5, P4, P2 |
| | Rotary Printing Presses | P5 |
| | Rotary Tables of Vertical Presses, etc. | P5, P4 |
| | Roll Necks of Cold Rolling Mill Backup Rolls | Higher than P4 |
| | Slewing Bearings for Parabolic Antennas | Higher than P4 |
| **Extra high speed is required** | Dental Drills | CLASS 7P, CLASS 5P |
| | Gyroscopes | CLASS 7P, P4 |
| | High Frequency Spindles | CLASS 7P, P4 |
| | Superchargers | P5, P4 |
| | Centrifugal Separators | P5, P4 |
| | Main Shafts of Jet Engines | Higher than P4 |
| **Low torque and low torque variation are required** | Gyroscope Gimbals | CLASS 7P, P4 |
| | Servomechanisms | CLASS 7P, CLASS 5P |
| | Potentiometric Controllers | CLASS 7P |


F6
G6
G7
H6
H7
JS6
JS7
K5
K6
K7
M6
N6
P6
f6
g5
g6
h5
h6
h7
js5
js6
k5
k6
m5
m6
n6

## 8. FITS AND INTERNAL CLEARANCES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## 8.1 Fits

### 8.1.1 Importance of Proper Fits

In the case of a rolling bearing with the inner ring fitted to the shaft with only slight interference, a harmful circumferential slipping may occur between the inner ring and shaft. This slipping of the inner ring, which is called "creep", results in a circumferential displacement of the ring relative to the shaft if the interference fit is not sufficiently tight. When creep occurs, the fitted surfaces become abraded, causing wear and considerable damage to the shaft. Abnormal heating and vibration may also occur due to abrasive metallic particles entering the interior of the bearing.

It is important to prevent creep by having sufficient interference to firmly secure that ring which rotates to either the shaft or housing. Creep cannot always be eliminated using only axial tightening through the bearing ring faces. Generally, it is not necessary, however, to provide interference for rings subjected only to stationary loads. Fits are sometimes made without any interference for either the inner or outer ring, to accommodate certain operating conditions, or to facilitate mounting and dismounting. In this case, to prevent damage to the fitting surfaces due to creep, lubrication of other applicable methods should be considered.

### 8.1.2 Selection of Fit

#### (1) Load Conditions and Fit

The proper fit may be selected from Table 8.1 based on the load and operating conditions.

#### (2) Magnitude of Load and Interference

The interference of the inner ring is slightly reduced by the bearing load; therefore, the loss of interference should be estimated using the following equations:

$$\left.\begin{aligned} \Delta d_F &= 0.08 \sqrt{\frac{d}{B} F_r} \times 10^{-3} \quad \cdots\cdots\cdots \text{(N)} \\ \Delta d_F &= 0.25 \sqrt{\frac{d}{B} F_r} \times 10^{-3} \quad \cdots\cdots \text{\{kgf\}} \end{aligned}\right\} \cdots \textbf{(8.1)}$$

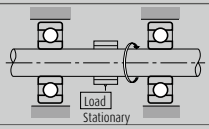
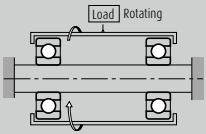
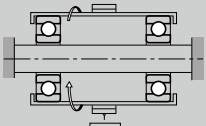
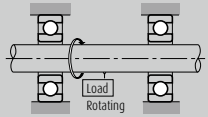
where $\Delta d_F$ : Interference decrease of inner ring (mm)

$d$ : Bearing bore diameter (mm)

$B$ : Nominal inner ring width (mm)

$F_r$ : Radial load applied on bearing (N), {kgf}

**Table 8.1 Loading Conditions and Fits**

| Load Application | Bearing Operation | | Load Conditions | Fitting | |
|---|---|---|---|---|---|
| | Inner Ring | Outer Ring | | Inner Ring | Outer Ring |
|   | Rotating | Stationary | Rotating Inner Ring Load<br>Stationary Outer Ring Load | Tight Fit | Loose Fit |
|   | Stationary | Rotating | | | |
|   | Stationary | Rotating | Rotating Outer Ring Load<br>Stationary Inner Ring Load | Loose Fit | Tight Fit |
|   | Rotating | Stationary | | | |
| Direction of load indeterminate due to variation of direction or unbalanced load | Rotating or Stationary | Rotating or Stationary | Direction of Load Indeterminate | Tight Fit | Tight Fit |

Therefore, the effective interference $\Delta d$ should be larger than the interference given by Equation (8.1).

However, in the case of heavy loads where the radial load exceeds 20% of the basic static load rating $C_{0r}$, under the operating condition, interference often becomes insufficient. Therefore, interference should be estimated using Equation (8.2):

$$\left.\begin{aligned} \Delta d \geqq 0.02\ \frac{F_r}{B} \times 10^{-3} \quad \cdots\cdots\cdots\ (\mathrm{N}) \\ \Delta d \geqq 0.2\ \frac{F_r}{B} \times 10^{-3} \quad \cdots\cdots\cdots\ \{\mathrm{kgf}\} \end{aligned}\right\} \cdots\cdots\ (\mathbf{8.2})$$

where $\Delta d$ : Effective interference (mm)

$F_r$ : Radial load applied on bearing (N), {kgf}

B : Nominal inner ring width (mm)

Creep experiments conducted by NSK with NU219 bearings showed a linear relation between radial load (load at creep occurrence limit) and required effective interference.

It was confirmed that this line agrees well with the straight line of Equation (8.2).

For NU219, with the interference given by Equation (8.1) for loads heavier than 0.25 $C_{0r}$, the interference becomes insufficient and creep occurs.

Generally speaking, the necessary interference for loads heavier than 0.25 $C_{0r}$ should be calculated using Equation (8.2). When doing this, sufficient care should be taken to prevent excessive circumferential stress.

### Calculation example

For NU219, B=32 (mm) and assume

$F_r$=98 100 N {10 000 kgf}

$C_{0r}$=183 000 N {18 600 kgf}

$$\frac{F_r}{C_{0r}} = \frac{98\ 100}{183\ 000} = 0.536 > 0.2$$

Therefore, the required effective interference is calculated using Equation (8.2).

$$\Delta d = 0.02 \times \frac{98\ 100}{32} \times 10^{-3} = 0.061\ (\mathrm{mm})$$

This result agrees well with Fig. 8.1.

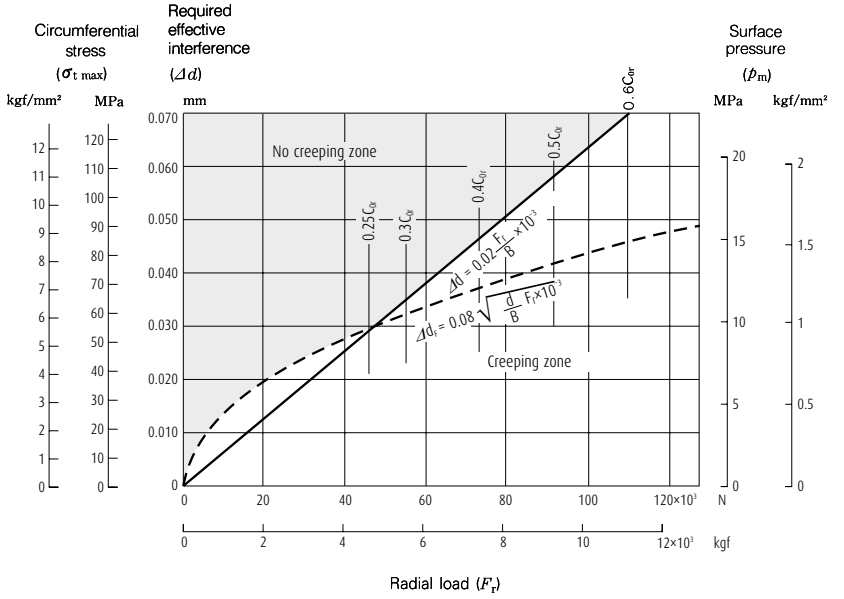



Fig. 8.1 Load and Required Effective Interference for Fit

### (3) Interference Variation Caused by Temperature Difference between Bearing and Shaft or Housing

The effective interference decreases due to the increasing bearing temperature during operation. If the temperature difference between the bearing and housing is $\Delta T$ (°C), then the temperature difference between the fitted surfaces of the shaft and inner ring is estimated to be about (0.1~0.15) $\Delta T$ in case that the shaft is cooled. The decrease in the interference of the inner ring due to this temperature difference $\Delta d_T$ may be calculated using Equation (8.3):

$$\Delta d_T = (0.10 \text{ to } 0.15) \times \Delta T \cdot \alpha \cdot d \fallingdotseq 0.0015 \Delta T \cdot d \times 10^{-3} \quad \cdots\cdots (8.3)$$

where $\Delta d_T$ : Decrease in interference of inner ring due to temperature difference (mm)

$\Delta T$ : Temperature difference between bearing interior and surrounding parts (°C)

$\alpha$ : Coefficient of linear expansion of bearing steel = $12.5 \times 10^{-6}$ (1/°C)

d : Bearing nominal bore diameter (mm)

In addition, depending on the temperature difference between the outer ring and housing, or difference in their coefficients of linear expansion, the interference may increase.

### (4) Effective Interference and Finish of Shaft and Housing

Since the roughness of fitted surfaces is reduced during fitting, the effective interference becomes less than the apparent interference. The amount of this interference decrease varies depending on the roughness of the surfaces and may be estimated using the following equations:

For grounded shafts $$\Delta d = \frac{d}{d+2} \Delta d_a \quad \cdots\cdots (8.4)$$

For machined shafts $$\Delta d = \frac{d}{d+3} \Delta d_a \quad \cdots\cdots (8.5)$$

where $\Delta d$ : Effective interference (mm)

$\Delta d_a$ : Apparent interference (mm)

d : Bearing nominal bore diameter (mm)

According to Equations (8.4) and (8.5), the effective interference of bearings with a bore diameter of 30 to 150 mm is about 95% of the apparent interference.

### (5) Fitting Stress and Ring Expansion and Contraction

When bearings are mounted with interference on a shaft or in a housing, the rings either expand or contract and stress is produced. Excessive interference may damage the bearings; therefore, as a general guide, the maximum interference should be kept under approximately 7/10 000 of the shaft diameter.

The pressure between fitted surfaces, expansion or contraction of the rings, and circumferential stress may be calculated using the equations in Table 8.2.

## Table 8.2 Fit Conditions

| | Inner ring and shaft | Outer ring and housing |
|---|---|---|
| **Surface pressure $p_m$ (MPa) {kgf/mm²}** | Hollow shaft<br>$p_m = \frac{\Delta d}{d} \cdot \frac{1}{\left[\frac{m_s - 1}{m_s E_s} - \frac{m_i - 1}{m_i E_i}\right] + 2\left[\frac{k_0^2}{E_s(1 - k_0^2)} + \frac{1}{E_i(1 - k^2)}\right]}$<br>Solid shaft<br>$p_m = \frac{\Delta d}{d} \cdot \frac{1}{\left[\frac{m_s - 1}{m_s E_s} - \frac{m_i - 1}{m_i E_i} + \frac{2}{E_i(1 - k^2)}\right]}$ | Housing outside diameter<br>$p_m = \frac{\Delta D}{D} \cdot \frac{1}{\left[\frac{m_e - 1}{m_e E_e} - \frac{m_h - 1}{m_h E_h}\right] + 2\left[\frac{h^2}{E_e(1 - h^2)} + \frac{1}{E_h(1 - h_0^2)}\right]}$ |
| **Expansion of inner ring raceway $\Delta D_i$ (mm)**<br>**Contraction of outer ring raceway $\Delta D_e$ (mm)** | $\Delta D_i = 2d \frac{p_m}{E_i} \frac{k}{1 - k^2}$<br>$= \Delta d \cdot k \frac{1 - k_0^2}{1 - k^2 k_0^2}$ (hollow shaft)<br>$= \Delta d \cdot k$ (solid shaft) | $\Delta D_e = 2D \frac{p_m}{E_e} \frac{h}{1 - h^2}$<br>$= \Delta D \cdot h \frac{1 - h_0^2}{1 - h^2 h_0^2}$ |
| **Maximum stress $\sigma_{t\,max}$ (MPa) {kgf/mm²}** | Circumferential stress at inner ring bore fitting surface is maximum.<br>$\sigma_{t\,max} = p_m \frac{1 + k^2}{1 - k^2}$ | Circumferential stress at outer ring bore surface is maximum.<br>$\sigma_{t\,max} = p_m \frac{2}{1 - h^2}$ |
| **Symbols** | d : Shaft diameter, inner ring bore<br>$d_0$: Hollow shaft bore<br>$D_i$: Inner ring raceway diameter<br>$k = d/D_i$, $k_0 = d_0/d$<br>$E_i$: Inner ring Young,s modulus, 208 000 MPa {21 200 kgf/mm²}<br>$E_s$: Shaft Young,s modulus<br>$m_i$: Inner ring poisson,s number, 3.33<br>$m_s$: Shaft poisson,s number | D : Housing bore diameter, outer ring outside diameter<br>$D_0$: Housing outside diameter<br>$D_e$: Outer ring raceway diameter<br>$h = De/D$, $h_0 = D/D_0$<br>$E_e$: Outer ring Young,s modulus, 208 000 MPa {21 200 kgf/mm²}<br>$E_h$: Housing Young,s modulus<br>mh: Outer ring poisson,s number, 3.33<br>$m_h$: Housing poisson's number |

### (6) Surface Pressure and Maximum Stress on Fitting Surfaces

In order for rolling bearings to achieve their full life expectancy, their fitting must be appropriate. Usually for an inner ring, which is the rotating ring, an interference fit is chosen, and for a fixed outer ring, a loose fit is used. To select the fit, the magnitude of the load, the temperature differences among the bearing and shaft and housing, the material characteristics of the shaft and housing, the level of finish, the material thickness, and the bearing mounting/dismounting method must all be considered. If the interference is insufficient for the operating conditions, ring loosening, creep, fretting, heat generation, etc. may occur. If the interference is excessive, the ring may crack. The magnitude of the interference is usually satisfactory if it is set for the size of the shaft or housing listed in the bearing manufacturer's catalog. To determine the surface pressure and stress on the fitting surfaces, calculations can be made assuming a thick-walled cylinder with uniform internal and external pressures. To do this, the necessary equations are summarized in Table 8.2. For convenience in the fitting of bearing inner rings on solid steel shafts, which are the most common, the surface pressure and maximum stress are shown in Figs. 8.3 and 8.4.

Fig. 8.3 shows the surface pressure $p_m$ and maximum stress $\sigma_{t\,max}$ variations with shaft diameter when interference results from the mean values of the tolerance grade shaft and bearing bore tolerances. Fig. 8.4 shows the maximum surface pressure $p_m$ and maximum stress $\sigma_{t\,max}$ when maximum interference occurs. Fig. 8.4 is convenient for checking whether $\sigma_{t\,max}$ exceeds the tolerances. The tensile strength of hardened bearing steel is about 1 570 to 1 960 MPa {160 to 200 kgf/mm²}. However, for safety, plan for a maximum fitting stress of 127 MPa {13 kgf/mm²}. For reference, the distributions of circumferential stress $\sigma_t$ and radial stress $\sigma_r$ in an inner ring are shown in Fig. 8.2.

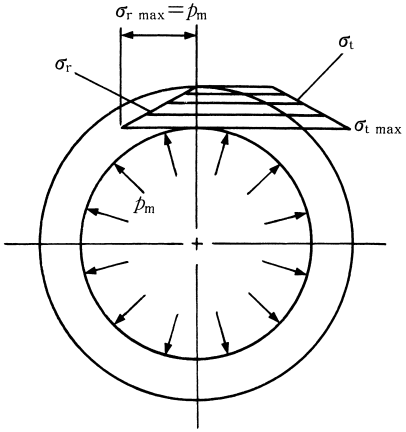



Fig. 8.2 Distribution of Circumferential Stress $\sigma_t$ and Radial Stress $\sigma_r$

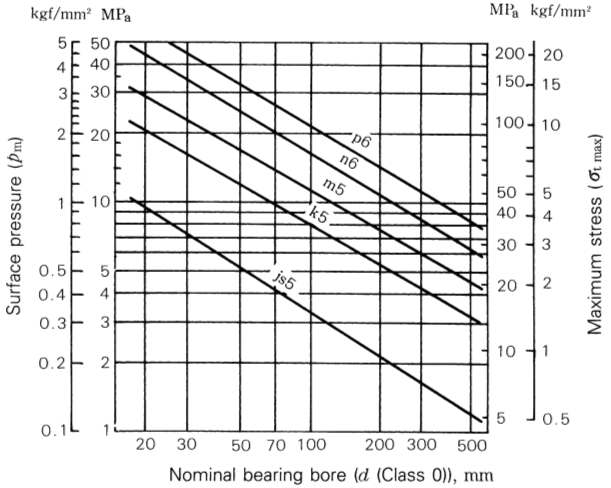



Fig. 8.3 Surface Pressure $p_m$ and Maximum Stress $\sigma_t$ max for Mean Interference in Various Tolerance Grades



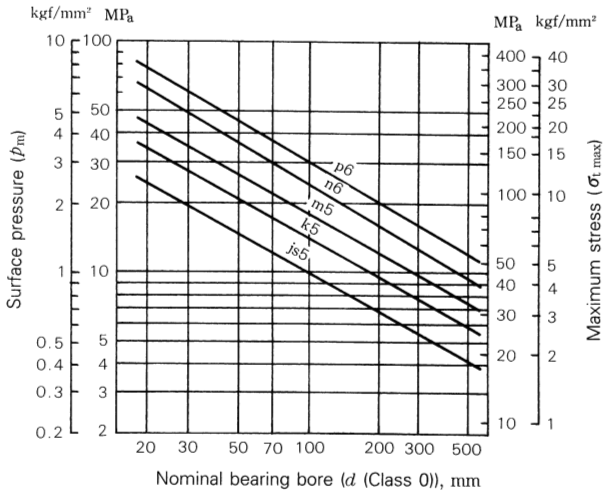



Fig. 8.4 Surface Pressure $p_m$ and Maximum Stress $\sigma_{t\,max}$ for Maximum Interference in Various Tolerance Grades

## (7) Mounting and Withdrawal Loads

The push-up load needed to mount bearings on shafts or in a housing hole with interference can be obtained using the thick-walled cylinder theory. The mounting load (or withdrawal load) depends upon the contact area, surface pressure, and coefficient of friction between the fitting surfaces. The mounting load (or withdrawal load) K needed to mount inner rings on shafts is given by Equation (8.6).

$$K=\mu\, p_m\, \pi\, d\, B \text{ (N), \{kgf\}} \quad \cdots\cdots (\mathbf{8.6})$$

where $\mu$: Coefficient of friction between fitting surfaces
$\mu$=0.12 (for mounting)
$\mu$=0.18 (for withdrawal)

$p_m$: Surface pressure (MPa), {kgf/mm$^2$}
For example, inner ring surface pressure can be obtained using Table 8.2.

$$p_m=\frac{E}{2}\,\frac{\Delta d}{d}\,\frac{(1-k^2)\,(1-k_0^2)}{1-k^2\,k_0^2}$$

$d$: Shaft diameter (mm)
$B$: Bearing width (mm)
$\Delta d$: Effective interference (mm)
$E$: Young's modulus of steel (MPa), {kgf/mm$^2$}
$E$=208 000 MPa {21 200 kgf/mm$^2$}
$k$: Inner ring thickness ratio
$k=d/D_i$
$D_i$: Inner ring raceway diameter (mm)
$k_0$: Hollow shaft thickness ratio
$k_0=d_0/d$
$d_0$: Bore diameter of hollow shaft (mm)

**For solid shafts**, $d_0$=0, consequently $k_0$=0. The value of k varies depending on the bearing type and size, but it usually ranges between k=0.7 and 0.9. Assuming that k=0.8 and the shaft is solid, Equation (8.6) is:

$$\left.\begin{aligned} K &= 118\,000\,\mu\,\Delta d\,B \text{ (N)} \\ &= 12\,000\,\mu\,\Delta d\,B \text{ \{kgf\}} \end{aligned}\right\} \quad \cdots\cdots (\mathbf{8.7})$$

Equation (8.7) is shown graphically in Fig. 8.5. The mounting and withdrawal loads for outer rings and housings have been calculated and the results are shown in Fig. 8.6. The actual mounting and withdrawal loads can become much higher than the calculated values if the bearing ring and shaft (or housing) are slightly misaligned or the load is applied unevenly to the circumference of the bearing ring hole. Consequently, the loads obtained from Figs. 8.5 and 8.6 should be considered only as guides when designing withdrawal tools, their strength should be five to six times higher than that indicated by the figures.

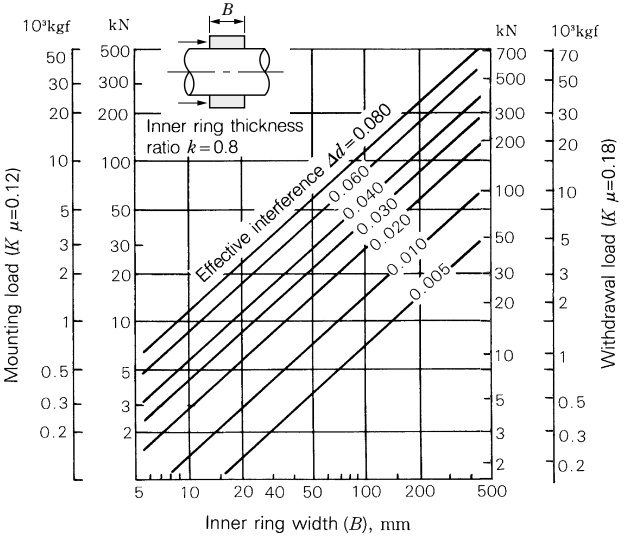



Fig. 8.5 Mounting and Withdrawal Loads for Inner Rings

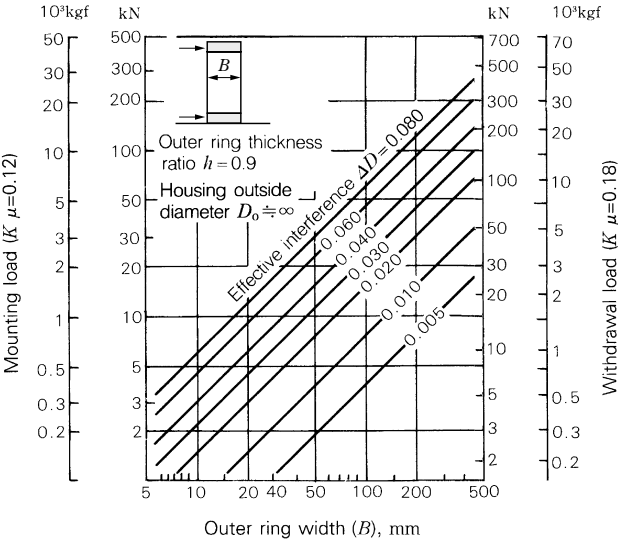



Fig. 8.6 Mounting and Withdrawal Loads for Outer Rings

### 8.1.3 Recommended Fits

As described previously, many factors, such as the characteristics and magnitude of bearing load, temperature differences, means of bearing mounting and dismounting, must be considered when selecting the proper fit.

If the housing is thin or the bearing is mounted on a hollow shaft, a tighter than usual fit is necessary. A split housing often deforms the bearing into an oval shape; therefore, a split housing should be avoided when a tight fit with the outer ring is required.

The fits of both the inner and outer rings should be tight in applications where the shaft is subjected to considerable vibration.

The recommended fits for some common applications are shown in Table 8.3 to 8.8. In the case of unusual operating conditions, it is advisable to consult NSK. For the accuracy and surface finish of shafts and housings, please refer to Section 13.1 (Page A270).

## Table 8.3 Fits of Radial Bearings with Shafts

| Load Conditions | | Examples | Shaft Diameter (mm) | | | Tolerance of Shaft | Remarks |
|---|---|---|---|---|---|---|---|
| | | | Ball Brgs. | Cylindrical Roller Brgs., Tapered Roller Brgs. | Spherical Roller Brgs. | | |
| **Radial Bearings with Cylindrical Bores** | | | | | | | |
| Rotating Outer Ring Load | Easy axial displacement of inner ring on shaft desirable. | Wheels on Stationary Axles | All Shaft Diameters | | | g6 | Use g5 and h5 where accuracy is required. In case of large bearings, f6 can be used to allow easy axial movement. |
| | Easy axial displacement of inner ring on shaft unnecessary | Tension Pulleys Rope Sheaves | | | | h6 | |
| Rotating Inner Ring Load or Direction of Load Indeterminate | Light Loads or Variable Loads ($<0.06C_r$(1)) | Electrical Home Appliances Pumps, Blowers, Transport Vehicles, Precision Machinery, Machine Tools | <18 | – | – | js5 | |
| | | | 18 to 100 | <40 | – | js6(j6) | |
| | | | 100 to 200 | 40 to 140 | – | k6 | |
| | | | – | 140 to 200 | – | m6 | |
| | Normal Loads ($0.06$ to $0.13C_r$(1)) | General Bearing Applications, Medium and Large Motors(3), Turbines, Pumps, Engine Main Bearings, Gears, Woodworking Machines | <18 | – | – | js5 or js6 (j5 or j6) | k6 and m6 can be used for single-row tapered roller bearings and single-row angular contact ball bearings instead of k5 and m5. |
| | | | 18 to 100 | <40 | <40 | k5 or k6 | |
| | | | 100 to 140 | 40 to 100 | 40 to 65 | m5 or m6 | |
| | | | 140 to 200 | 100 to 140 | 65 to 100 | m6 | |
| | | | 200 to 280 | 140 to 200 | 100 to 140 | n6 | |
| | | | – | 200 to 400 | 140 to 280 | p6 | |
| | | | – | – | 280 to 500 | r6 | |
| | | | – | – | over 500 | r7 | |
| | Heavy Loads or Shock Loads ($>0.13C_r$(1)) | Railway Axleboxes, Industrial Vehicles, Traction Motors, Construction Equipment, Crushers | – | 50 to 140 | 50 to 100 | n6 | More than CN bearing internal clearance is necessary. |
| | | | – | 140 to 200 | 100 to 140 | p6 | |
| | | | – | over 200 | 140 to 200 | r6 | |
| | | | – | – | 200 to 500 | r7 | |
| Axial Loads Only | | | All Shaft Diameters | | | js6 (j6) | – |
| **Radial Bearings with Tapered Bores and Sleeves** | | | | | | | |
| All Types of Loading | | General bearing Applications, Railway Axleboxes | All Shaft Diameters | | | h9/IT5(2) | IT5 and IT7 mean that the deviation of the shaft from its true geometric form, e. g. roundness and cylindricity should be within the tolerances of IT5 and IT7 respectively. |
| | | Transmission Shafts, Woodworking Spindles | | | | h10/IT7(2) | |

**Notes** (1) $C_r$ represents the basic load rating of the bearing.
(2) Refer to Appendix Table 11 on page C016 for the values of standard tolerance grades IT.
(3) Refer to Tables 8.14.1 and 8.14.2 for the recommended fits of shafts used in electric motors for deep groove ball bearings with bore diameters ranging from 10 mm to 160 mm, and for cylindrical roller bearings with bore diameters ranging from 24 mm to 200 mm.

**Remarks** This table is applicable only to solid steel shafts.

## Table 8.4 Fits of Thrust Bearings with Shafts

| Load Conditions | | Examples | Shaft Diameter (mm) | Tolerance of Shaft | Remarks |
|---|---|---|---|---|---|
| Central Axial Load Only | | Main Shafts of Lathes | All Shaft Diameters | h6 or js6 (j6) | – |
| Combined Radial and Axial Loads (Spherical Thrust Roller Bearings) | Stationary Inner Ring Load | Cone Crushers | All Shaft Diameters | js6 (j6) | |
| | Rotating Inner Ring Load or Direction of Load Indeterminate | Paper Pulp Refiners, Plastic Extruders | <200 | k6 | |
| | | | 200 to 400 | m6 | |
| | | | over 400 | n6 | |

## Table 8.5 Fits of Radial Bearings with Housings

| Load Conditions | | | Examples | Tolerances for Housing Bores | Axial Displacement of Outer Ring | Remarks |
|---|---|---|---|---|---|---|
| Solid Housings | Rotating Outer Ring Load | Heavy Loads on Bearing in Thin-Walled Housing or Heavy Shock Loads | Automotive Wheel Hubs (Roller Bearings) Crane Travelling Wheels | **P7** | Impossible | – |
| | | Normal or Heavy Loads | Automotive Wheel Hubs (Ball Bearings) Vibrating Screens | **N7** | | |
| | | Light or Variable Loads | Conveyor Rollers Rope Sheaves Tension Pulleys | **M7** | | |
| | Direction of Load Indeterminate | Heavy Shock Loads | Traction Motors | | | |
| | | Normal or Heavy Loads | Pumps Crankshaft Main Bearings Medium and Large Motors(1) | **K7** | Generally Impossible | If axial displacement of the outer ring is not required. |
| Solid or Split Housings | | Normal or Light Loads | | **JS7 (J7)** | Possible | Axial displacement of outer ring is necessary. |
| | Rotating Inner Ring Load | Loads of All kinds | General Bearing Applications, Railway Axleboxes | **H7** | Easily possible | – |
| | | Normal or Light Loads | Plummer Blocks | **H8** | | |
| | | High Temperature Rise of Inner Ring Through Shaft | Paper Dryers | **G7** | | |
| Solid Housing | | Accurate Running Desirable under Normal or Light Loads | Grinding Spindle Rear Ball Bearings High Speed Centrifugal Compressor Free Bearings | **JS6 (J6)** | Possible | – |
| | Direction of Load Indeterminate | | Grinding Spindle Front Ball Bearings High Speed Centrifugal Compressor Fixed Bearings | **K6** | Generally Impossible | For heavy loads, interference fit tighter than K is used. When high accuracy is required, very strict tolerances should be used for fitting. |
| | Rotating Inner Ring Load | Accurate Running and High Rigidity Desirable under Variable Loads | Cylindrical Roller Bearings for Machine Tool Main Spindle | **M6 or N6** | Impossible | |
| | | Minimum noise is required | Electrical Home Appliances | **H6** | Easily Possible | – |

**Note** (1) Refer to Tables 8.14.1 and 8.14.2 for the recommended fits of housing bores of deep groove ball bearings and cylindrical roller bearings for electric motors.

**Remarks**
1. This table is applicable to cast iron and steel housings. For housings made of light alloys, the interference should be tighter than those in this table.
2. Refer to the introductory section of the bearing dimension tables (blue pages) for special fits such as drawn cup needle roller bearings.

## Table 8.6 Fits of Thrust Bearings with Housings

| Load Conditions | | Bearing Types | Tolerances for Housing Bores | Remarks |
|---|---|---|---|---|
| Axial Loads Only | | Thrust Ball Bearings | **Clearance over 0.25 mm** | For General Applications |
| | | | **H8** | When precision is required |
| | | Spherical Thrust Roller Bearings Steep Angle Tapered Roller Bearings | **Outer ring has radial clearance.** | When radial loads are sustained by other bearings. |
| Combined Radial and Axial Loads | Stationary Outer Ring Loads | Spherical Thrust Roller Bearings | **H7 or JS7 (J7)** | – |
| | Rotating Outer Ring Loads or Direction of Load Indeterminate | | **K7** | Normal Loads |
| | | | **M7** | Relatively Heavy Radial Loads |

## Table 8.7 Fits of Inch Design Tapered Roller Bearings with Shafts

### (1) Bearings of Precision Classes 4 and 2

Units : μm

| Operating Conditions | | Nominal Bore Diameters d over (mm) | over 1/25.4 | incl. (mm) | incl. 1/25.4 | Bore Diameter Tolerances $\Delta_{ds}$ high | Bore Diameter Tolerances $\Delta_{ds}$ low | Shaft Diameter Tolerances high | Shaft Diameter Tolerances low | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Rotating Inner Ring Loads | Normal Loads | – | | 76.200 | 3.0000 | +13 | 0 | **+38** | **+25** | For bearings with d ≤ 152.4 mm, clearance is usually larger than CN. |
| | | 76.200 | 3.0000 | 304.800 | 12.0000 | +25 | 0 | **+64** | **+38** | |
| | | 304.800 | 12.0000 | 609.600 | 24.0000 | +51 | 0 | **+127** | **+76** | |
| | | 609.600 | 24.0000 | 914.400 | 36.0000 | +76 | 0 | **+190** | **+114** | |
| | Heavy Loads Shock Loads High Speeds | – | | 76.200 | 3.0000 | +13 | 0 | **+64** | **+38** | In general, bearings with a clearance larger than CN are used. ※ means that the average interference is about 0.0005 d. |
| | | 76.200 | 3.0000 | 304.800 | 12.0000 | +25 | 0 | ※ | | |
| | | 304.800 | 12.0000 | 609.600 | 24.0000 | +51 | 0 | ※ | | |
| | | 609.600 | 24.0000 | 914.400 | 36.0000 | +76 | 0 | **+381** | **+305** | |
| Rotating Outer Ring Loads | Normal Loads without Shocks | – | | 76.200 | 3.0000 | +13 | 0 | **+13** | **0** | The inner ring cannot be displaced axially. When heavy or shock loads exist, the figures in the above (Rotating inner ring loads, heavy or shock loads) apply. |
| | | 76.200 | 3.0000 | 304.800 | 12.0000 | +25 | 0 | **+25** | **0** | |
| | | 304.800 | 12.0000 | 609.600 | 24.0000 | +51 | 0 | **+51** | **0** | |
| | | 609.600 | 24.0000 | 914.400 | 36.0000 | +76 | 0 | **+76** | **0** | |
| | | – | | 76.200 | 3.0000 | +13 | 0 | **0** | **-13** | The inner ring can be displaced axially. |
| | | 76.200 | 3.0000 | 304.800 | 12.0000 | +25 | 0 | **0** | **-25** | |
| | | 304.800 | 12.0000 | 609.600 | 24.0000 | +51 | 0 | **0** | **-51** | |
| | | 609.600 | 24.0000 | 914.400 | 36.0000 | +76 | 0 | **0** | **-76** | |

### (2) Bearings of Precision Classes 3 and 0 (1)

Units : μm

| Operating Conditions | | Nominal Bore Diameters d over (mm) | over 1/25.4 | incl. (mm) | incl. 1/25.4 | Bore Diameter Tolerances $\Delta_{ds}$ high | Bore Diameter Tolerances $\Delta_{ds}$ low | Shaft Diameter Tolerances high | Shaft Diameter Tolerances low | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Rotating Inner Ring Loads | Precision Machine-Tool Main Spindles | – | | 76.200 | 3.0000 | +13 | 0 | **+30** | **+18** | – |
| | | 76.200 | 3.0000 | 304.800 | 12.0000 | +13 | 0 | **+30** | **+18** | |
| | | 304.800 | 12.0000 | 609.600 | 24.0000 | +25 | 0 | **+64** | **+38** | |
| | | 609.600 | 24.0000 | 914.400 | 36.0000 | +38 | 0 | **+102** | **+64** | |
| | Heavy Loads Shock Loads High Speeds | – | | 76.200 | 3.0000 | +13 | 0 | – | | A minimum interference of about 0.00025 d is used. |
| | | 76.200 | 3.0000 | 304.800 | 12.0000 | +13 | 0 | – | | |
| | | 304.800 | 12.0000 | 609.600 | 24.0000 | +25 | 0 | – | | |
| | | 609.600 | 24.0000 | 914.400 | 36.0000 | +38 | 0 | – | | |
| Rotating Outer Ring Loads | Precision Machine-Tool Main Spindles | – | | 76.200 | 3.0000 | +13 | 0 | **+30** | **+18** | – |
| | | 76.200 | 3.0000 | 304.800 | 12.0000 | +13 | 0 | **+30** | **+18** | |
| | | 304.800 | 12.0000 | 609.600 | 24.0000 | +25 | 0 | **+64** | **+38** | |
| | | 609.600 | 24.0000 | 914.400 | 36.0000 | +38 | 0 | **+102** | **+64** | |

Note (1) For bearings with d greater than 304.8 mm, Class 0 does not exist.

## Table 8.8 Fits of Inch Design Tapered Roller Bearings with Housings

### (1) Bearings of Precision Classes 4 and 2

Units : μm

| Operating Conditions | | Nominal Outside Diameters D over (mm) | over 1/25.4 | incl. (mm) | incl. 1/25.4 | Outside Diameter Tolerances $\Delta_{Ds}$ high | $\Delta_{Ds}$ low | Housing Bore Diameter Tolerances high | Housing Bore Diameter Tolerances low | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Rotating Inner Ring Loads | Used either on free-end or fixed-end | – | | 76.200 | 3.0000 | +25 | 0 | **+76** | **+51** | The outer ring can be easily displaced axially. |
| | | 76.200 | 3.0000 | 127.000 | 5.0000 | +25 | 0 | **+76** | **+51** | |
| | | 127.000 | 5.0000 | 304.800 | 12.0000 | +25 | 0 | **+76** | **+51** | |
| | | 304.800 | 12.0000 | 609.600 | 24.0000 | +51 | 0 | **+152** | **+102** | |
| | | 609.600 | 24.0000 | 914.400 | 36.0000 | +76 | 0 | **+229** | **+152** | |
| | The outer ring position can be adjusted axially. | – | | 76.200 | 3.0000 | +25 | 0 | **+25** | **0** | The outer ring can be displaced axially. |
| | | 76.200 | 3.0000 | 127.000 | 5.0000 | +25 | 0 | **+25** | **0** | |
| | | 127.000 | 5.0000 | 304.800 | 12.0000 | +25 | 0 | **+51** | **0** | |
| | | 304.800 | 12.0000 | 609.600 | 24.0000 | +51 | 0 | **+76** | **+25** | |
| | | 609.600 | 24.0000 | 914.400 | 36.0000 | +76 | 0 | **+127** | **+51** | |
| | The outer ring position cannot be adjusted axially. | – | | 76.200 | 3.0000 | +25 | 0 | **-13** | **-38** | Generally, the outer ring is fixed axially. |
| | | 76.200 | 3.0000 | 127.000 | 5.0000 | +25 | 0 | **-25** | **-51** | |
| | | 127.000 | 5.0000 | 304.800 | 12.0000 | +25 | 0 | **-25** | **-51** | |
| | | 304.800 | 12.0000 | 609.600 | 24.0000 | +51 | 0 | **-25** | **-76** | |
| | | 609.600 | 24.0000 | 914.400 | 36.0000 | +76 | 0 | **-25** | **-102** | |
| Rotating Outer Ring Loads | Normal Loads The outer ring position cannot be adjusted axially. | – | | 76.200 | 3.0000 | +25 | 0 | **-13** | **-38** | The outer ring is fixed axially. |
| | | 76.200 | 3.0000 | 127.000 | 5.0000 | +25 | 0 | **-25** | **-51** | |
| | | 127.000 | 5.0000 | 304.800 | 12.0000 | +25 | 0 | **-25** | **-51** | |
| | | 304.800 | 12.0000 | 609.600 | 24.0000 | +51 | 0 | **-25** | **-76** | |
| | | 609.600 | 24.0000 | 914.400 | 36.0000 | +76 | 0 | **-25** | **-102** | |

### (2) Bearings of Precision Classes 3 and 0 (1)

Units : μm

| Operating Conditions | | Nominal Outside Diameters D over (mm) | over 1/25.4 | incl. (mm) | incl. 1/25.4 | Outside Diameter Tolerances $\Delta_{Ds}$ high | $\Delta_{Ds}$ low | Housing Bore Diameter Tolerances high | Housing Bore Diameter Tolerances low | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Rotating Inner Ring Loads | Used on free-end | – | | 152.400 | 6.0000 | +13 | 0 | **+38** | **+25** | The outer ring can be easily displaced axially. |
| | | 152.400 | 6.0000 | 304.800 | 12.0000 | +13 | 0 | **+38** | **+25** | |
| | | 304.800 | 12.0000 | 609.600 | 24.0000 | +25 | 0 | **+64** | **+38** | |
| | | 609.600 | 24.0000 | 914.400 | 36.0000 | +38 | 0 | **+89** | **+51** | |
| | Used on fixed-end | – | | 152.400 | 6.0000 | +13 | 0 | **+25** | **+13** | The outer ring can be displaced axially. |
| | | 152.400 | 6.0000 | 304.800 | 12.0000 | +13 | 0 | **+25** | **+13** | |
| | | 304.800 | 12.0000 | 609.600 | 24.0000 | +25 | 0 | **+51** | **+25** | |
| | | 609.600 | 24.0000 | 914.400 | 36.0000 | +38 | 0 | **+76** | **+38** | |
| | The outer ring position can be adjusted axially. | – | | 152.400 | 6.0000 | +13 | 0 | **+13** | **0** | Generally, the outer ring is fixed axially. |
| | | 152.400 | 6.0000 | 304.800 | 12.0000 | +13 | 0 | **+25** | **0** | |
| | | 304.800 | 12.0000 | 609.600 | 24.0000 | +25 | 0 | **+25** | **0** | |
| | | 609.600 | 24.0000 | 914.400 | 36.0000 | +38 | 0 | **+38** | **0** | |
| | The outer ring position cannot be adjusted axially. | – | | 152.400 | 6.0000 | +13 | 0 | **0** | **-13** | The outer ring is fixed axially. |
| | | 152.400 | 6.0000 | 304.800 | 12.0000 | +13 | 0 | **0** | **-25** | |
| | | 304.800 | 12.0000 | 609.600 | 24.0000 | +25 | 0 | **0** | **-25** | |
| | | 609.600 | 24.0000 | 914.400 | 36.0000 | +38 | 0 | **0** | **-38** | |
| Rotating Outer Ring Loads | Normal Loads The outer ring position cannot be adjusted axially. | – | | 76.200 | 3.0000 | +13 | 0 | **-13** | **-25** | The outer ring is fixed axially. |
| | | 76.200 | 3.0000 | 152.400 | 6.0000 | +13 | 0 | **-13** | **-25** | |
| | | 152.400 | 6.0000 | 304.800 | 12.0000 | +13 | 0 | **-13** | **-38** | |
| | | 304.800 | 12.0000 | 609.600 | 24.0000 | +25 | 0 | **-13** | **-38** | |
| | | 609.600 | 24.0000 | 914.400 | 36.0000 | +38 | 0 | **-13** | **-51** | |

**Note** (1) For bearings with D greater than 304.8 mm, Class 0 does not exist.

8

## 8.2 Bearing Internal Clearance

### 8.2.1 Internal Clearance and Their Standards

The internal clearance in rolling bearings in operation greatly influences bearing performance including fatigue life, vibration, noise, heat-generation, etc. Consequently, the selection of the proper internal clearance is one of the most important tasks when choosing a bearing after the type and size have been determined.

This bearing internal clearance is the combined clearance between the inner/outer rings and rolling elements. The radial and axial clearance are defined as the total amount that one ring can be displaced relative to the other in the radial and axial directions respectively (Fig. 8.1).

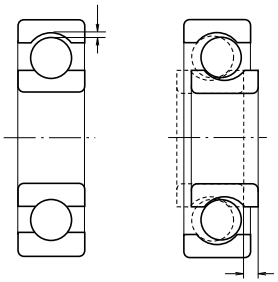



Fig. 8.7 Bearing Internal Clearance

To obtain accurate measurements, the clearance is generally measured by applying a specified measuring load on the bearing; therefore, the measured clearance (sometimes called "measured clearance" to make a distinction) is always slightly larger than the theoretical internal clearance (called "geometrical clearance" for radial bearings) by the amount of elastic deformation caused by the measuring load.

Therefore, the theoretical internal clearance may be obtained by correcting the measured clearance by the amount of elastic deformation. However, in the case of roller bearings this elastic deformation is negligibly small.

Usually the clearance before mounting is the one specified as the theoretical internal clearance.

In Table 8.9, reference table and page numbers are listed by bearing types.

### Table 8.9 Index for Radial Internal Clearance by Bearing Types

| Bearing Types | | Table Number | Page Number |
|---|---|---|---|
| Deep Groove Ball Bearings | | **8.10** | A169 |
| Extra Small and Miniature Ball Bearings | | **8.11** | A169 |
| Magneto Bearings | | **8.12** | A169 |
| Self-Aligning Ball Bearings | | **8.13** | A170 |
| Deep Groove Ball Bearings | For Motors | **8.14.1** | A170 |
| Cylindrical Roller Bearings | For Motors | **8.14.2** | A170 |
| Cylindrical Roller Bearings | With Cylindrical Bores<br>With Cylindrical Bores (Matched)<br>With Tapered Bores (Matched) | **8.15** | A171 |
| Spherical Roller Bearings | With Cylindrical Bores<br>With Tapered Bores | **8.16** | A172 |
| Double-Row and Combined Tapered Roller Bearings | | **8.17** | A173 |
| Combined Angular Contact Ball Bearings (1) | | **8.18** | A174 |
| Four-Point Contact Ball Bearings (1) | | **8.19** | A174 |

Note (1) Values given are axial clearance.

## Table 8.10 Radial Internal Clearance in Deep Groove Ball Bearings

Units : μm

| Nominal Bore Diameter d (mm) | | Clearance | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | C2 | | CN | | C3 | | C4 | | C5 | |
| over | incl. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. |
| 10 only | | 0 | 7 | 2 | 13 | 8 | 23 | 14 | 29 | 20 | 37 |
| 10 | 18 | 0 | 9 | 3 | 18 | 11 | 25 | 18 | 33 | 25 | 45 |
| 18 | 24 | 0 | 10 | 5 | 20 | 13 | 28 | 20 | 36 | 28 | 48 |
| 24 | 30 | 1 | 11 | 5 | 20 | 13 | 28 | 23 | 41 | 30 | 53 |
| 30 | 40 | 1 | 11 | 6 | 20 | 15 | 33 | 28 | 46 | 40 | 64 |
| 40 | 50 | 1 | 11 | 6 | 23 | 18 | 36 | 30 | 51 | 45 | 73 |
| 50 | 65 | 1 | 15 | 8 | 28 | 23 | 43 | 38 | 61 | 55 | 90 |
| 65 | 80 | 1 | 15 | 10 | 30 | 25 | 51 | 46 | 71 | 65 | 105 |
| 80 | 100 | 1 | 18 | 12 | 36 | 30 | 58 | 53 | 84 | 75 | 120 |
| 100 | 120 | 2 | 20 | 15 | 41 | 36 | 66 | 61 | 97 | 90 | 140 |
| 120 | 140 | 2 | 23 | 18 | 48 | 41 | 81 | 71 | 114 | 105 | 160 |
| 140 | 160 | 2 | 23 | 18 | 53 | 46 | 91 | 81 | 130 | 120 | 180 |
| 160 | 180 | 2 | 25 | 20 | 61 | 53 | 102 | 91 | 147 | 135 | 200 |
| 180 | 200 | 2 | 30 | 25 | 71 | 63 | 117 | 107 | 163 | 150 | 230 |
| 200 | 225 | 2 | 35 | 25 | 85 | 75 | 140 | 125 | 195 | 175 | 265 |
| 225 | 250 | 2 | 40 | 30 | 95 | 85 | 160 | 145 | 225 | 205 | 300 |
| 250 | 280 | 2 | 45 | 35 | 105 | 90 | 170 | 155 | 245 | 225 | 340 |
| 280 | 315 | 2 | 55 | 40 | 115 | 100 | 190 | 175 | 270 | 245 | 370 |
| 315 | 355 | 3 | 60 | 45 | 125 | 110 | 210 | 195 | 300 | 275 | 410 |
| 355 | 400 | 3 | 70 | 55 | 145 | 130 | 240 | 225 | 340 | 315 | 460 |
| 400 | 450 | 3 | 80 | 60 | 170 | 150 | 270 | 250 | 380 | 350 | 510 |
| 450 | 500 | 3 | 90 | 70 | 190 | 170 | 300 | 280 | 420 | 390 | 570 |
| 500 | 560 | 10 | 100 | 80 | 210 | 190 | 330 | 310 | 470 | 440 | 630 |
| 560 | 630 | 10 | 110 | 90 | 230 | 210 | 360 | 340 | 520 | 490 | 690 |
| 630 | 710 | 20 | 130 | 110 | 260 | 240 | 400 | 380 | 570 | 540 | 760 |
| 710 | 800 | 20 | 140 | 120 | 290 | 270 | 450 | 430 | 630 | 600 | 840 |

**Remarks** To obtain the measured values, use the clearance correction for radial clearance increase caused by the measuring load in the table below.
For the C2 clearance class, the smaller value should be used for bearings with minimum clearance and the larger value for bearings near the maximum clearance range.

Units : μm

| Nominal Bore Diameter d (mm) | | Measuring Load | | Radial Clearance Correction Amount | | | | |
|---|---|---|---|---|---|---|---|---|
| over | incl. | (N) | {kgf} | C2 | CN | C3 | C4 | C5 |
| 10 (incl) | 18 | 24.5 | {2.5} | 3 to 4 | 4 | 4 | 4 | 4 |
| 18 | 50 | 49 | {5} | 4 to 5 | 5 | 6 | 6 | 6 |
| 50 | 280 | 147 | {15} | 6 to 8 | 8 | 9 | 9 | 9 |

**Remarks** For values exceeding 280 mm, please contact NSK.

## Table 8.11 Radial Internal Clearance in Extra Small and Miniature Ball Bearings

Units : μm

| Clearance Symbol | MC1 | | MC2 | | MC3 | | MC4 | | MC5 | | MC6 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Clearance | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. |
| | 0 | 5 | 3 | 8 | 5 | 10 | 8 | 13 | 13 | 20 | 20 | 28 |

**Remarks**
1. The standard clearance is MC3.
2. To obtain the measured value, add correction amount in the table below.

Units : μm

| Clearance Symbol | MC1 | MC2 | MC3 | MC4 | MC5 | MC6 |
|---|---|---|---|---|---|---|
| Clearance Correction Value | 1 | 1 | 1 | 1 | 2 | 2 |

The measuring loads are as follows:

For miniature ball bearings*
2.5 N {0.25 kgf}

For extra small ball bearings*
4.4 N {0.45 kgf}

* For their classification, refer to Table 1 on Page B054

## Table 8.12 Radial Internal Clearance in Magneto Bearings

Units : μm

| Nominal Bore Diameter d (mm) | | Bearing Series | Clearance | |
|---|---|---|---|---|
| over | incl. | | min. | max. |
| 2.5 | 30 | EN | 10 | 50 |
| | | E | 30 | 60 |

## Table 8.13 Radial Internal Clearance in Self-Aligning Ball Bearings

Units : µm

| Nominal Bore Diameter d (mm) | | Clearance in Bearings with Cylindrical Bores | | | | | | | | | | Clearance in Bearings with Tapered Bores | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | C2 | | CN | | C3 | | C4 | | C5 | | C2 | | CN | | C3 | | C4 | | C5 | |
| over | incl. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max |
| 2.5 | 6 | 1 | 8 | 5 | 15 | 10 | 20 | 15 | 25 | 21 | 33 | – | – | – | – | – | – | – | – | – | – |
| 6 | 10 | 2 | 9 | 6 | 17 | 12 | 25 | 19 | 33 | 27 | 42 | – | – | – | – | – | – | – | – | – | – |
| 10 | 14 | 2 | 10 | 6 | 19 | 13 | 26 | 21 | 35 | 30 | 48 | – | – | – | – | – | – | – | – | – | – |
| 14 | 18 | 3 | 12 | 8 | 21 | 15 | 28 | 23 | 37 | 32 | 50 | – | – | – | – | – | – | – | – | – | – |
| 18 | 24 | 4 | 14 | 10 | 23 | 17 | 30 | 25 | 39 | 34 | 52 | 7 | 17 | 13 | 26 | 20 | 33 | 28 | 42 | 37 | 55 |
| 24 | 30 | 5 | 16 | 11 | 24 | 19 | 35 | 29 | 46 | 40 | 58 | 9 | 20 | 15 | 28 | 23 | 39 | 33 | 50 | 44 | 62 |
| 30 | 40 | 6 | 18 | 13 | 29 | 23 | 40 | 34 | 53 | 46 | 66 | 12 | 24 | 19 | 35 | 29 | 46 | 40 | 59 | 52 | 72 |
| 40 | 50 | 6 | 19 | 14 | 31 | 25 | 44 | 37 | 57 | 50 | 71 | 14 | 27 | 22 | 39 | 33 | 52 | 45 | 65 | 58 | 79 |
| 50 | 65 | 7 | 21 | 16 | 36 | 30 | 50 | 45 | 69 | 62 | 88 | 18 | 32 | 27 | 47 | 41 | 61 | 56 | 80 | 73 | 99 |
| 65 | 80 | 8 | 24 | 18 | 40 | 35 | 60 | 54 | 83 | 76 | 108 | 23 | 39 | 35 | 57 | 50 | 75 | 69 | 98 | 91 | 123 |
| 80 | 100 | 9 | 27 | 22 | 48 | 42 | 70 | 64 | 96 | 89 | 124 | 29 | 47 | 42 | 68 | 62 | 90 | 84 | 116 | 109 | 144 |
| 100 | 120 | 10 | 31 | 25 | 56 | 50 | 83 | 75 | 114 | 105 | 145 | 35 | 56 | 50 | 81 | 75 | 108 | 100 | 139 | 130 | 170 |
| 120 | 140 | 10 | 38 | 30 | 68 | 60 | 100 | 90 | 135 | 125 | 175 | 40 | 68 | 60 | 98 | 90 | 130 | 120 | 165 | 155 | 205 |
| 140 | 160 | 15 | 44 | 35 | 80 | 70 | 120 | 110 | 161 | 150 | 210 | 45 | 74 | 65 | 110 | 100 | 150 | 140 | 191 | 180 | 240 |

## Table 8.14 Radial Internal Clearance in Bearings for Electric Motors

### Table 8.14.1 Deep Groove Ball Bearings for Electric Motors

Units : µm

| Nominal Bore Diameter d (mm) | | Clearance | | Remarks | |
|---|---|---|---|---|---|
| | | CM | | Recommended Fit | |
| over | incl. | min. | max. | Shaft | Housing Bore |
| 10 (incl.) | 18 | 4 | 11 | js5 (j5) | H6, H7(1) or JS6, JS7 (J6, J7)(2) |
| 18 | 30 | 5 | 12 | k5 | |
| 30 | 50 | 9 | 17 | | |
| 50 | 80 | 12 | 22 | | |
| 80 | 100 | 18 | 30 | | |
| 100 | 120 | 18 | 30 | m5 | |
| 120 | 160 | 24 | 38 | | |

**Notes** (1) Applicable to outer rings that require movement in the axial direction.
(2) Applicable to outer rings that do not require movement in the axial direction.

**Remarks** The radial clearance increase caused by the measuring load is equal to the correction amount for CN clearance in the remarks under Table 8.10.

### Table 8.14.2 Cylindrical Roller Bearings for Electric Motors

Units : µm

| Nominal Bore Diameter d (mm) | | Clearance | | | | Remarks | |
|---|---|---|---|---|---|---|---|
| | | Interchangeable CT | | Non-Interchangeable CM | | Recommended Fit | |
| over | incl. | min. | max. | min. | max. | Shaft | Housing Bore |
| 24 | 40 | 15 | 35 | 15 | 30 | k5 | JS6, JS7 (J6, J7)(1) or K6, K7(2) |
| 40 | 50 | 20 | 40 | 20 | 35 | m5 | |
| 50 | 65 | 25 | 45 | 25 | 40 | | |
| 65 | 80 | 30 | 50 | 30 | 45 | | |
| 80 | 100 | 35 | 60 | 35 | 55 | | |
| 100 | 120 | 35 | 65 | 35 | 60 | | |
| 120 | 140 | 40 | 70 | 40 | 65 | | |
| 140 | 160 | 50 | 85 | 50 | 80 | | |
| 160 | 180 | 60 | 95 | 60 | 90 | n6 | |
| 180 | 200 | 65 | 105 | 65 | 100 | | |

**Notes** (1) Applicable to outer rings that require movement in the axial direction.
(2) Applicable to outer rings that do not require movement in the axial direction.

## Table 8.15 Radial Internal Clearance in Cylindrical Roller Bearings and Solid-Type Needle Roller Bearings

Units : µm

| Nominal Bore Diameter d (mm) | | Clearance in Bearings with Cylindrical Bores | | | | | | | | | | Clearance in Non-Interchangeable Bearings with Cylindrical Bores | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | C2 | | CN | | C3 | | C4 | | C5 | | CC1 | | CC2 | | CC (1) | | CC3 | | CC4 | | CC5 | |
| over | incl. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. |
| – | 10 | 0 | 25 | 20 | 45 | 35 | 60 | 50 | 75 | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 10 | 24 | 0 | 25 | 20 | 45 | 35 | 60 | 50 | 75 | 65 | 90 | 5 | 15 | 10 | 20 | 20 | 30 | 35 | 45 | 45 | 55 | 65 | 75 |
| 24 | 30 | 0 | 25 | 20 | 45 | 35 | 60 | 50 | 75 | 70 | 95 | 5 | 15 | 10 | 25 | 25 | 35 | 40 | 50 | 50 | 60 | 70 | 80 |
| 30 | 40 | 5 | 30 | 25 | 50 | 45 | 70 | 60 | 85 | 80 | 105 | 5 | 15 | 12 | 25 | 25 | 40 | 45 | 55 | 55 | 70 | 80 | 95 |
| 40 | 50 | 5 | 35 | 30 | 60 | 50 | 80 | 70 | 100 | 95 | 125 | 5 | 18 | 15 | 30 | 30 | 45 | 50 | 65 | 65 | 80 | 95 | 110 |
| 50 | 65 | 10 | 40 | 40 | 70 | 60 | 90 | 80 | 110 | 110 | 140 | 5 | 20 | 15 | 35 | 35 | 50 | 55 | 75 | 75 | 90 | 110 | 130 |
| 65 | 80 | 10 | 45 | 40 | 75 | 65 | 100 | 90 | 125 | 130 | 165 | 10 | 25 | 20 | 40 | 40 | 60 | 70 | 90 | 90 | 110 | 130 | 150 |
| 80 | 100 | 15 | 50 | 50 | 85 | 75 | 110 | 105 | 140 | 155 | 190 | 10 | 30 | 25 | 45 | 45 | 70 | 80 | 105 | 105 | 125 | 155 | 180 |
| 100 | 120 | 15 | 55 | 50 | 90 | 85 | 125 | 125 | 165 | 180 | 220 | 10 | 30 | 25 | 50 | 50 | 80 | 95 | 120 | 120 | 145 | 180 | 205 |
| 120 | 140 | 15 | 60 | 60 | 105 | 100 | 145 | 145 | 190 | 200 | 245 | 10 | 35 | 30 | 60 | 60 | 90 | 105 | 135 | 135 | 160 | 200 | 230 |
| 140 | 160 | 20 | 70 | 70 | 120 | 115 | 165 | 165 | 215 | 225 | 275 | 10 | 35 | 35 | 65 | 65 | 100 | 115 | 150 | 150 | 180 | 225 | 260 |
| 160 | 180 | 25 | 75 | 75 | 125 | 120 | 170 | 170 | 220 | 250 | 300 | 10 | 40 | 35 | 75 | 75 | 110 | 125 | 165 | 165 | 200 | 250 | 285 |
| 180 | 200 | 35 | 90 | 90 | 145 | 140 | 195 | 195 | 250 | 275 | 330 | 15 | 45 | 40 | 80 | 80 | 120 | 140 | 180 | 180 | 220 | 275 | 315 |
| 200 | 225 | 45 | 105 | 105 | 165 | 160 | 220 | 220 | 280 | 305 | 365 | 15 | 50 | 45 | 90 | 90 | 135 | 155 | 200 | 200 | 240 | 305 | 350 |
| 225 | 250 | 45 | 110 | 110 | 175 | 170 | 235 | 235 | 300 | 330 | 395 | 15 | 50 | 50 | 100 | 100 | 150 | 170 | 215 | 215 | 265 | 330 | 380 |
| 250 | 280 | 55 | 125 | 125 | 195 | 190 | 260 | 260 | 330 | 370 | 440 | 20 | 55 | 55 | 110 | 110 | 165 | 185 | 240 | 240 | 295 | 370 | 420 |
| 280 | 315 | 55 | 130 | 130 | 205 | 200 | 275 | 275 | 350 | 410 | 485 | 20 | 60 | 60 | 120 | 120 | 180 | 205 | 265 | 265 | 325 | 410 | 470 |
| 315 | 355 | 65 | 145 | 145 | 225 | 225 | 305 | 305 | 385 | 455 | 535 | 20 | 65 | 65 | 135 | 135 | 200 | 225 | 295 | 295 | 360 | 455 | 520 |
| 355 | 400 | 100 | 190 | 190 | 280 | 280 | 370 | 370 | 460 | 510 | 600 | 25 | 75 | 75 | 150 | 150 | 225 | 255 | 330 | 330 | 405 | 510 | 585 |
| 400 | 450 | 110 | 210 | 210 | 310 | 310 | 410 | 410 | 510 | 565 | 665 | 25 | 85 | 85 | 170 | 170 | 255 | 285 | 370 | 370 | 455 | 565 | 650 |
| 450 | 500 | 110 | 220 | 220 | 330 | 330 | 440 | 440 | 550 | 625 | 735 | 25 | 95 | 95 | 190 | 190 | 285 | 315 | 410 | 410 | 505 | 625 | 720 |

**Note** (1) CC denotes normal clearance for non-Interchangeable cylindrical roller bearings and solid-type needle roller bearings.

Units : µm

| Nominal Bore Diameter d (mm) | | Clearance in Non-Interchangeable Bearings with Tapered Bores | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CC9 (1) | | CC0 | | CC1 | | CC2 | | CC (2) | | CC3 | | CC4 | | CC5 | |
| over | incl. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. |
| 10 | 24 | 5 | 10 | – | – | 10 | 20 | 20 | 30 | 35 | 45 | 45 | 55 | 55 | 65 | 75 | 85 |
| 24 | 30 | 5 | 10 | 8 | 15 | 10 | 25 | 25 | 35 | 40 | 50 | 50 | 60 | 60 | 70 | 80 | 95 |
| 30 | 40 | 5 | 12 | 8 | 15 | 12 | 25 | 25 | 40 | 45 | 55 | 55 | 70 | 70 | 80 | 95 | 110 |
| 40 | 50 | 5 | 15 | 10 | 20 | 15 | 30 | 30 | 45 | 50 | 65 | 65 | 80 | 80 | 95 | 110 | 125 |
| 50 | 65 | 5 | 15 | 10 | 20 | 15 | 35 | 35 | 50 | 55 | 75 | 75 | 90 | 90 | 110 | 130 | 150 |
| 65 | 80 | 10 | 20 | 15 | 30 | 20 | 40 | 40 | 60 | 70 | 90 | 90 | 110 | 110 | 130 | 150 | 170 |
| 80 | 100 | 10 | 25 | 20 | 35 | 25 | 45 | 45 | 70 | 80 | 105 | 105 | 125 | 125 | 150 | 180 | 205 |
| 100 | 120 | 10 | 25 | 20 | 35 | 25 | 50 | 50 | 80 | 95 | 120 | 120 | 145 | 145 | 170 | 205 | 230 |
| 120 | 140 | 15 | 30 | 25 | 40 | 30 | 60 | 60 | 90 | 105 | 135 | 135 | 160 | 160 | 190 | 230 | 260 |
| 140 | 160 | 15 | 35 | 30 | 50 | 35 | 65 | 65 | 100 | 115 | 150 | 150 | 180 | 180 | 215 | 260 | 295 |
| 160 | 180 | 15 | 35 | 30 | 50 | 35 | 75 | 75 | 110 | 125 | 165 | 165 | 200 | 200 | 240 | 285 | 320 |
| 180 | 200 | 20 | 40 | 30 | 50 | 40 | 80 | 80 | 120 | 140 | 180 | 180 | 220 | 220 | 260 | 315 | 355 |
| 200 | 225 | 20 | 45 | 35 | 60 | 45 | 90 | 90 | 135 | 155 | 200 | 200 | 240 | 240 | 285 | 350 | 395 |
| 225 | 250 | 25 | 50 | 40 | 65 | 50 | 100 | 100 | 150 | 170 | 215 | 215 | 265 | 265 | 315 | 380 | 430 |
| 250 | 280 | 25 | 55 | 40 | 70 | 55 | 110 | 110 | 165 | 185 | 240 | 240 | 295 | 295 | 350 | 420 | 475 |
| 280 | 315 | 30 | 60 | – | – | 60 | 120 | 120 | 180 | 205 | 265 | 265 | 325 | 325 | 385 | 470 | 530 |
| 315 | 355 | 30 | 65 | – | – | 65 | 135 | 135 | 200 | 225 | 295 | 295 | 360 | 360 | 430 | 520 | 585 |
| 355 | 400 | 35 | 75 | – | – | 75 | 150 | 150 | 225 | 255 | 330 | 330 | 405 | 405 | 480 | 585 | 660 |
| 400 | 450 | 40 | 85 | – | – | 85 | 170 | 170 | 255 | 285 | 370 | 370 | 455 | 455 | 540 | 650 | 735 |
| 450 | 500 | 45 | 95 | – | – | 95 | 190 | 190 | 285 | 315 | 410 | 410 | 505 | 505 | 600 | 720 | 815 |

**Notes** (1) Clearance CC9 is applicable to cylindrical roller bearings with tapered bores in ISO Tolerance Classes 5 and 4.
(2) CC denotes normal clearance for non-Interchangeable cylindrical roller bearings and solid-type needle roller bearings.

## Table 8.16 Radial Internal Clearance in Spherical Roller Bearings

Units : µm

| Nominal Bore Diameter d (mm) | | Clearance in Bearings with Cylindrical Bores | | | | | | | | | | Clearance in Bearings with Tapered Bores | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | C2 | | CN | | C3 | | C4 | | C5 | | C2 | | CN | | C3 | | C4 | | C5 | |
| over | incl. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. |
| 24 | 30 | 15 | 25 | 25 | 40 | 40 | 55 | 55 | 75 | 75 | 95 | 20 | 30 | 30 | 40 | 40 | 55 | 55 | 75 | 75 | 95 |
| 30 | 40 | 15 | 30 | 30 | 45 | 45 | 60 | 60 | 80 | 80 | 100 | 25 | 35 | 35 | 50 | 50 | 65 | 65 | 85 | 85 | 105 |
| 40 | 50 | 20 | 35 | 35 | 55 | 55 | 75 | 75 | 100 | 100 | 125 | 30 | 45 | 45 | 60 | 60 | 80 | 80 | 100 | 100 | 130 |
| 50 | 65 | 20 | 40 | 40 | 65 | 65 | 90 | 90 | 120 | 120 | 150 | 40 | 55 | 55 | 75 | 75 | 95 | 95 | 120 | 120 | 160 |
| 65 | 80 | 30 | 50 | 50 | 80 | 80 | 110 | 110 | 145 | 145 | 180 | 50 | 70 | 70 | 95 | 95 | 120 | 120 | 150 | 150 | 200 |
| 80 | 100 | 35 | 60 | 60 | 100 | 100 | 135 | 135 | 180 | 180 | 225 | 55 | 80 | 80 | 110 | 110 | 140 | 140 | 180 | 180 | 230 |
| 100 | 120 | 40 | 75 | 75 | 120 | 120 | 160 | 160 | 210 | 210 | 260 | 65 | 100 | 100 | 135 | 135 | 170 | 170 | 220 | 220 | 280 |
| 120 | 140 | 50 | 95 | 95 | 145 | 145 | 190 | 190 | 240 | 240 | 300 | 80 | 120 | 120 | 160 | 160 | 200 | 200 | 260 | 260 | 330 |
| 140 | 160 | 60 | 110 | 110 | 170 | 170 | 220 | 220 | 280 | 280 | 350 | 90 | 130 | 130 | 180 | 180 | 230 | 230 | 300 | 300 | 380 |
| 160 | 180 | 65 | 120 | 120 | 180 | 180 | 240 | 240 | 310 | 310 | 390 | 100 | 140 | 140 | 200 | 200 | 260 | 260 | 340 | 340 | 430 |
| 180 | 200 | 70 | 130 | 130 | 200 | 200 | 260 | 260 | 340 | 340 | 430 | 110 | 160 | 160 | 220 | 220 | 290 | 290 | 370 | 370 | 470 |
| 200 | 225 | 80 | 140 | 140 | 220 | 220 | 290 | 290 | 380 | 380 | 470 | 120 | 180 | 180 | 250 | 250 | 320 | 320 | 410 | 410 | 520 |
| 225 | 250 | 90 | 150 | 150 | 240 | 240 | 320 | 320 | 420 | 420 | 520 | 140 | 200 | 200 | 270 | 270 | 350 | 350 | 450 | 450 | 570 |
| 250 | 280 | 100 | 170 | 170 | 260 | 260 | 350 | 350 | 460 | 460 | 570 | 150 | 220 | 220 | 300 | 300 | 390 | 390 | 490 | 490 | 620 |
| 280 | 315 | 110 | 190 | 190 | 280 | 280 | 370 | 370 | 500 | 500 | 630 | 170 | 240 | 240 | 330 | 330 | 430 | 430 | 540 | 540 | 680 |
| 315 | 355 | 120 | 200 | 200 | 310 | 310 | 410 | 410 | 550 | 550 | 690 | 190 | 270 | 270 | 360 | 360 | 470 | 470 | 590 | 590 | 740 |
| 355 | 400 | 130 | 220 | 220 | 340 | 340 | 450 | 450 | 600 | 600 | 750 | 210 | 300 | 300 | 400 | 400 | 520 | 520 | 650 | 650 | 820 |
| 400 | 450 | 140 | 240 | 240 | 370 | 370 | 500 | 500 | 660 | 660 | 820 | 230 | 330 | 330 | 440 | 440 | 570 | 570 | 720 | 720 | 910 |
| 450 | 500 | 140 | 260 | 260 | 410 | 410 | 550 | 550 | 720 | 720 | 900 | 260 | 370 | 370 | 490 | 490 | 630 | 630 | 790 | 790 | 1 000 |
| 500 | 560 | 150 | 280 | 280 | 440 | 440 | 600 | 600 | 780 | 780 | 1 000 | 290 | 410 | 410 | 540 | 540 | 680 | 680 | 870 | 870 | 1 100 |
| 560 | 630 | 170 | 310 | 310 | 480 | 480 | 650 | 650 | 850 | 850 | 1 100 | 320 | 460 | 460 | 600 | 600 | 760 | 760 | 980 | 980 | 1 230 |
| 630 | 710 | 190 | 350 | 350 | 530 | 530 | 700 | 700 | 920 | 920 | 1 190 | 350 | 510 | 510 | 670 | 670 | 850 | 850 | 1 090 | 1 090 | 1 360 |
| 710 | 800 | 210 | 390 | 390 | 580 | 580 | 770 | 770 | 1 010 | 1 010 | 1 300 | 390 | 570 | 570 | 750 | 750 | 960 | 960 | 1 220 | 1 220 | 1 500 |
| 800 | 900 | 230 | 430 | 430 | 650 | 650 | 860 | 860 | 1 120 | 1 120 | 1 440 | 440 | 640 | 640 | 840 | 840 | 1 070 | 1 070 | 1 370 | 1 370 | 1 690 |
| 900 | 1 000 | 260 | 480 | 480 | 710 | 710 | 930 | 930 | 1 220 | 1 220 | 1 570 | 490 | 710 | 710 | 930 | 930 | 1 190 | 1 190 | 1 520 | 1 520 | 1 860 |
| 1 000 | 1 120 | 290 | 530 | 530 | 780 | 780 | 1 020 | 1 020 | 1 330 | – | – | 530 | 770 | 770 | 1 030 | 1 030 | 1 300 | 1 300 | 1 670 | – | – |
| 1 120 | 1 250 | 320 | 580 | 580 | 860 | 860 | 1 120 | 1 120 | 1 460 | – | – | 570 | 830 | 830 | 1 120 | 1 120 | 1 420 | 1 420 | 1 830 | – | – |
| 1 250 | 1 400 | 350 | 640 | 640 | 950 | 950 | 1 240 | 1 240 | 1 620 | – | – | 620 | 910 | 910 | 1 230 | 1 230 | 1 560 | 1 560 | 2 000 | – | – |

## Table 8.17 Radial Internal Clearance in Double-Row and Combined Tapered Roller Bearings

Units : μm

| Cylindrical Bore / Tapered Bore / Nominal Bore Diameterd (mm) | | Clearance | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | C1 | | C2 | | CN | | C3 | | C4 | | C5 | |
| | | – | | C1 | | C2 | | CN | | C3 | | C4 | |
| over | incl. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. |
| – | 18 | 0 | 10 | 10 | 20 | 20 | 30 | 35 | 45 | 50 | 60 | 65 | 75 |
| 18 | 24 | 0 | 10 | 10 | 20 | 20 | 30 | 35 | 45 | 50 | 60 | 65 | 75 |
| 24 | 30 | 0 | 10 | 10 | 20 | 20 | 30 | 40 | 50 | 50 | 60 | 70 | 80 |
| 30 | 40 | 0 | 12 | 12 | 25 | 25 | 40 | 45 | 60 | 60 | 75 | 80 | 95 |
| 40 | 50 | 0 | 15 | 15 | 30 | 30 | 45 | 50 | 65 | 65 | 80 | 95 | 110 |
| 50 | 65 | 0 | 15 | 15 | 35 | 35 | 55 | 60 | 80 | 80 | 100 | 110 | 130 |
| 65 | 80 | 0 | 20 | 20 | 40 | 40 | 60 | 70 | 90 | 90 | 110 | 130 | 150 |
| 80 | 100 | 0 | 25 | 25 | 50 | 50 | 75 | 80 | 105 | 105 | 130 | 155 | 180 |
| 100 | 120 | 5 | 30 | 30 | 55 | 55 | 80 | 90 | 115 | 120 | 145 | 180 | 210 |
| 120 | 140 | 5 | 35 | 35 | 65 | 65 | 95 | 100 | 130 | 135 | 165 | 200 | 230 |
| 140 | 160 | 10 | 40 | 40 | 70 | 70 | 100 | 110 | 140 | 150 | 180 | 220 | 260 |
| 160 | 180 | 10 | 45 | 45 | 80 | 80 | 115 | 125 | 160 | 165 | 200 | 250 | 290 |
| 180 | 200 | 10 | 50 | 50 | 90 | 90 | 130 | 140 | 180 | 180 | 220 | 280 | 320 |
| 200 | 225 | 20 | 60 | 60 | 100 | 100 | 140 | 150 | 190 | 200 | 240 | 300 | 340 |
| 225 | 250 | 20 | 65 | 65 | 110 | 110 | 155 | 165 | 210 | 220 | 270 | 330 | 380 |
| 250 | 280 | 20 | 70 | 70 | 120 | 120 | 170 | 180 | 230 | 240 | 290 | 370 | 420 |
| 280 | 315 | 30 | 80 | 80 | 130 | 130 | 180 | 190 | 240 | 260 | 310 | 410 | 460 |
| 315 | 355 | 30 | 80 | 80 | 130 | 140 | 190 | 210 | 260 | 290 | 350 | 450 | 510 |
| 355 | 400 | 40 | 90 | 90 | 140 | 150 | 200 | 220 | 280 | 330 | 390 | 510 | 570 |
| 400 | 450 | 45 | 95 | 95 | 145 | 170 | 220 | 250 | 310 | 370 | 430 | 560 | 620 |
| 450 | 500 | 50 | 100 | 100 | 150 | 190 | 240 | 280 | 340 | 410 | 470 | 620 | 680 |
| 500 | 560 | 60 | 110 | 110 | 160 | 210 | 260 | 310 | 380 | 450 | 520 | 700 | 770 |
| 560 | 630 | 70 | 120 | 120 | 170 | 230 | 290 | 350 | 420 | 500 | 570 | 780 | 850 |
| 630 | 710 | 80 | 130 | 130 | 180 | 260 | 310 | 390 | 470 | 560 | 640 | 870 | 950 |
| 710 | 800 | 90 | 140 | 150 | 200 | 290 | 340 | 430 | 510 | 630 | 710 | 980 | 1 060 |
| 800 | 900 | 100 | 150 | 160 | 210 | 320 | 370 | 480 | 570 | 700 | 790 | 1 100 | 1 200 |
| 900 | 1 000 | 120 | 170 | 180 | 230 | 360 | 410 | 540 | 630 | 780 | 870 | 1 200 | 1 300 |
| 1 000 | 1 120 | 130 | 190 | 200 | 260 | 400 | 460 | 600 | 700 | – | – | – | – |
| 1 120 | 1 250 | 150 | 210 | 220 | 280 | 450 | 510 | 670 | 770 | – | – | – | – |
| 1 250 | 1 400 | 170 | 240 | 250 | 320 | 500 | 570 | 750 | 870 | – | – | – | – |

**Remarks** Axial internal clearance $\Delta_a = \Delta_r \cot\alpha \fallingdotseq \frac{1.5}{e}\Delta_r$

where $\Delta_r$ : Radial internal clearance
$\alpha$ : Contact angle
e : Constant (Listed in bearing tables)

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## Table 8.18 Axial Internal Clearance in Combined Angular Contact Ball Bearings (Measured Clearance)

Units : μm

| Nominal Bore Diameter d (mm) | | Axial Internal Clearance | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Contact Angle 30° | | | | | | Contact Angle 40° | | | | | |
| | | CN | | C3 | | C4 | | CN | | C3 | | C4 | |
| over | incl. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. |
| – | 10 | 9 | 29 | 29 | 49 | 49 | 69 | 6 | 26 | 26 | 46 | 46 | 66 |
| 10 | 18 | 10 | 30 | 30 | 50 | 50 | 70 | 7 | 27 | 27 | 47 | 47 | 67 |
| 18 | 24 | 19 | 39 | 39 | 59 | 59 | 79 | 13 | 33 | 33 | 53 | 53 | 73 |
| 24 | 30 | 20 | 40 | 40 | 60 | 60 | 80 | 14 | 34 | 34 | 54 | 54 | 74 |
| 30 | 40 | 26 | 46 | 46 | 66 | 66 | 86 | 19 | 39 | 39 | 59 | 59 | 79 |
| 40 | 50 | 29 | 49 | 49 | 69 | 69 | 89 | 21 | 41 | 41 | 61 | 61 | 81 |
| 50 | 65 | 35 | 60 | 60 | 85 | 85 | 110 | 25 | 50 | 50 | 75 | 75 | 100 |
| 65 | 80 | 38 | 63 | 63 | 88 | 88 | 115 | 27 | 52 | 52 | 77 | 77 | 100 |
| 80 | 100 | 49 | 74 | 74 | 99 | 99 | 125 | 35 | 60 | 60 | 85 | 85 | 110 |
| 100 | 120 | 72 | 97 | 97 | 120 | 120 | 145 | 52 | 77 | 77 | 100 | 100 | 125 |
| 120 | 140 | 85 | 115 | 115 | 145 | 145 | 175 | 63 | 93 | 93 | 125 | 125 | 155 |
| 140 | 160 | 90 | 120 | 120 | 150 | 150 | 180 | 66 | 96 | 96 | 125 | 125 | 155 |
| 160 | 180 | 95 | 125 | 125 | 155 | 155 | 185 | 68 | 98 | 98 | 130 | 130 | 160 |
| 180 | 200 | 110 | 140 | 140 | 170 | 170 | 200 | 80 | 110 | 110 | 140 | 140 | 170 |

**Remarks** This table is applicable to bearings in Tolerance Classes Normal and 6. For internal axial clearance in bearings in tolerance classes better than 5 and contact angles of 15° and 25°, it is advisable to consult NSK.

## Table 8.19 Axial Internal Clearance in Four-Point Contact Ball Bearings (Measured Clearance)

Units : μm

| Nominal Bore Diameter d (mm) | | Axial Internal Clearance | | | | | |
|---|---|---|---|---|---|---|---|
| | | CN | | C3 | | C4 | |
| over | incl. | min. | max. | min. | max. | min. | max. |
| 10 | 18 | 45 | 85 | 75 | 125 | 115 | 165 |
| 18 | 40 | 56 | 106 | 96 | 146 | 136 | 186 |
| 40 | 60 | 76 | 126 | 116 | 166 | 156 | 206 |
| 60 | 80 | 86 | 136 | 126 | 176 | 166 | 226 |
| 80 | 100 | 96 | 156 | 136 | 196 | 186 | 246 |
| 100 | 140 | 116 | 176 | 156 | 216 | 206 | 266 |
| 140 | 180 | 136 | 196 | 176 | 246 | 226 | 296 |
| 180 | 220 | 156 | 226 | 206 | 276 | 256 | 326 |
| 220 | 260 | 175 | 245 | 225 | 305 | 285 | 365 |
| 260 | 300 | 195 | 275 | 255 | 335 | 315 | 395 |
| 300 | 350 | 215 | 305 | 275 | 365 | 345 | 425 |
| 350 | 400 | 245 | 335 | 315 | 405 | 385 | 475 |
| 400 | 500 | 285 | 385 | 355 | 455 | 435 | 525 |

### 8.2.2 Selection of Bearing Internal Clearance

Among the bearing internal clearance listed in the tables, the CN Clearance is adequate for standard operating conditions. The clearance becomes progressively smaller from C2 to C1 and larger from C3 to C5.

Standard operating conditions are defined as those where the inner ring speed is less than approximately 50% of the limiting speed listed in the bearing tables, the load is less than normal ($P \fallingdotseq 0.1C_r$), and the bearing is tight-fitted on the shaft.

As a measure to reduce bearing noise for electric motors, the radial clearance range is narrower than the normal class and the values are somewhat smaller for deep groove ball bearings and cylindrical roller bearings for electric motors. (Refer to Table 8.14.1 and 8.14.2)

Internal clearance varies with the fit and temperature differences in operation. The changes in radial clearance in a roller bearing are shown in Fig. 8.8.

#### (1) Decrease in Radial Clearance Caused by Fitting and Residual Clearance

When the inner ring or the outer ring is tight-fitted on a shaft or in a housing, a decrease in the radial internal clearance is caused by the expansion or contraction of the bearing rings. The decrease varies according to the bearing type and size and design of the shaft and housing. The amount of this decrease is approximately 70 to 90% of the interference (refer to Section 8.1.2, Fits (5), Pages A156 and A157). The internal clearance after subtracting this decrease from the theoretical internal clearance $\Delta_0$ is called the residual clearance, $\Delta_f$.

### (2) Decrease in Radial Internal Clearance Caused by Temperature Differences between Inner and Outer Rings and Effective Clearance

The frictional heat generated during operation is conducted away through the shaft and housing. Since housings generally conduct heat better than shafts, the temperature of the inner ring and the rolling elements is usually higher than that of the outer ring by 5 to 10 °C. If the shaft is heated or the housing is cooled, the difference in temperature between the inner and outer rings is greater. The radial clearance decreases due to the thermal expansion caused by the temperature difference between the inner and outer rings. The amount of this decrease can be calculated using the following equations:

$$\delta_t \fallingdotseq \alpha \Delta_t D_e \cdots\cdots (8.8)$$

where $\delta_t$ : Decrease in radial clearance due to temperature difference between inner and outer rings (mm)

$\alpha$ : Coefficient of linear expansion of bearing steel $\fallingdotseq 12.5 \times 10^{-6}$ (1/°C)

$\Delta_t$ : Temperature difference between inner and outer rings (°C)

$D_e$ : Outer ring raceway diameter (mm)

For ball bearings

$$D_e \fallingdotseq \frac{1}{5}(4D+d) \cdots\cdots (8.9)$$

For roller bearings

$$D_e \fallingdotseq \frac{1}{4}(3D+d) \cdots\cdots (8.10)$$

The clearance after subtracting this $\delta_t$ from the residual clearance, $\Delta_f$ is called the effective clearance, $\Delta$. Theoretically, the longest life of a bearing can be expected when the effective clearance is slightly negative. However, it is difficult to achieve such an ideal condition, and an excessive negative clearance will greatly shorten the bearing life. Therefore, a clearance of zero or a slightly positive amount, instead of a negative one, should be selected. When single-row angular contact ball bearings or tapered roller bearings are used facing each other, there should be a small effective clearance, unless a preload is required. When two cylindrical roller bearings with a rib on one side are used facing each other, it is necessary to provide adequate axial clearance to allow for shaft elongation during operation.

The radial clearance used in some specific applications are given in Table 8.20. Under special operating conditions, it is advisable to consult NSK.

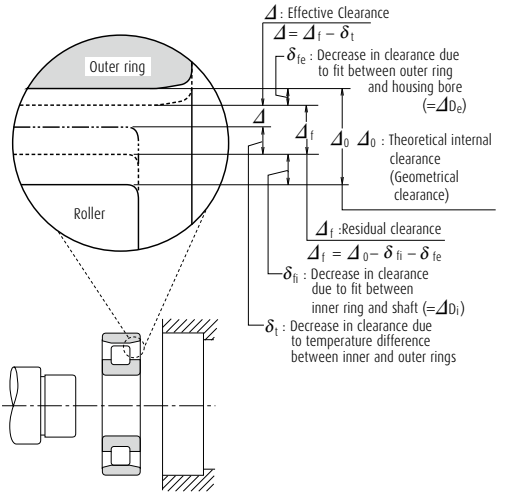


Fig. 8.8 Changes in Radial Internal Clearance of Bearings

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### Table 8.20 Examples of Clearance for Specific Applications

| Operating Conditions | Examples | Internal Clearance |
|---|---|---|
| **When shaft deflection is large.** | Semi-floating rear wheels of automobiles | C5 or equivalent |
| **When steam passes through hollow shafts or roller shafts are heated.** | Dryers in paper making machines | C3, C4 |
| | Table rollers for rolling mills | C3 |
| **When impact loads and vibration are severe or when both the inner and outer rings are tight-fitted.** | Traction motors for railways | C4 |
| | Vibrating screens | C3, C4 |
| | Fluid couplings | C4 |
| | Final reduction gears for tractors | C4 |
| **When both the inner and outer rings are loose-fitted** | Rolling mill roll necks | C2 or equivalent |
| **When noise and vibration restrictions are severe** | Small motors with special specifications | C1, C2, CM |
| **When clearance is adjusted after mounting to prevent shaft deflection, etc.** | Main shafts of lathes | CC9, CC1 |

## 8.3 Technical Data

### 8.3.1 Temperature Rise and Dimensional Change

Rolling bearings are extremely precise mechanical elements. Any change in dimensional accuracy due to temperature cannot be ignored. Accordingly, it is specified as a rule that measurement of a bearing must be made at 20°C and that the dimensions to be set forth in the standards must be expressed by values at 20°C.

Dimensional change due to temperature change not only affects the dimensional accuracy, but also causes change in the internal clearance of a bearing during operation. Dimensional change may cause interference between the inner ring and shaft or between the outer ring and housing bore. It is also possible to achieve shrink fitting with large interference by utilizing dimensional change induced by temperature difference. The dimensional change $\Delta l$ due to temperature rise can be expressed as in Equation (8.11) below:

$$\Delta l = \Delta T \, \alpha \, l \ (\text{mm}) \quad \cdots\cdots (\mathbf{8.11})$$

where, $\Delta l$: Dimensional change (mm)
$\Delta T$: temperature rise (°C)
$\alpha$: Coefficient of linear expansion for bearing steel
$\alpha = 12.5 \times 10^{-6}$ (1/°C)
$l$: Original dimension (mm)

Equation (8.11) may be illustrated as shown in Fig. 8.9. In the following cases, Fig. 8.9 can be utilized to easily obtain an approximate numerical values for dimensional change:

(1) To correct dimensional measurements according to the ambient air temperature
(2) To find the change in bearing internal clearance due to temperature difference between inner and outer rings during operation
(3) To find the relationship between the interference and heating temperature during shrink fitting
(4) To find the change in the interference when a temperature difference exists on the fit surface

**Example**

To what temperature should the inner ring be heated if an inner ring of 110 mm in bore is to be shrink fitted to a shaft belonging to the n6 tolerance range class? The maximum interference between the n6 shaft of 110 in diameter and the inner ring is 0.065. To enable insertion of the inner ring with ease on the shaft, there must be a clearance of 0.03 to 0.04. Accordingly, the amount to expand the inner ring must be 0.095 to 0.105. Intersection of a vertical axis $\Delta l$=0.105 and a horizontal axis l=110 is determined on a diagram. $\Delta T$ is located in the temperature range between 70°C and 80°C ($\Delta T \fallingdotseq 77$°C). Therefore, it is enough to set the inner ring heating temperature to the room temperature +80°C.

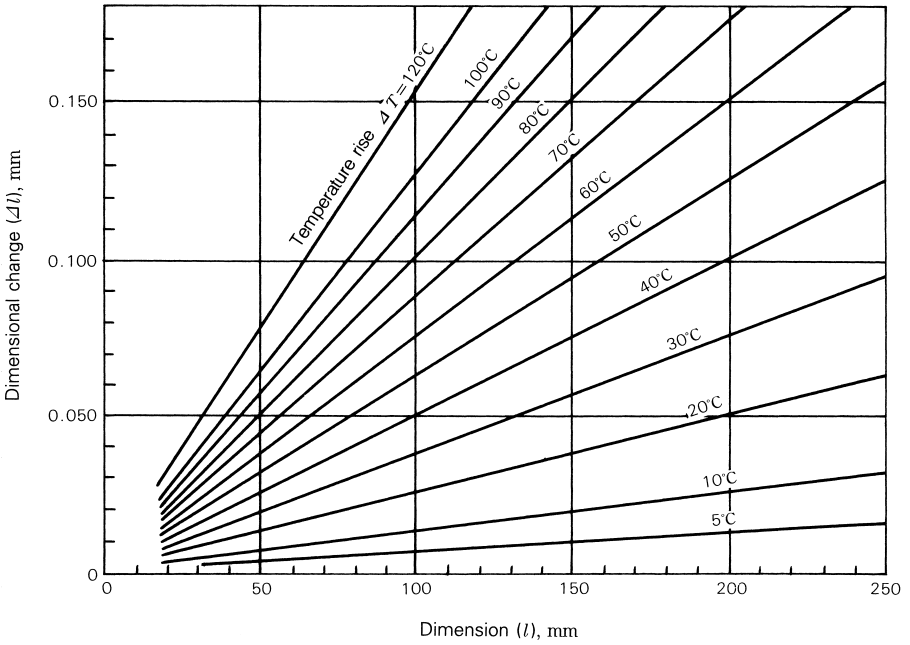



Fig. 8.9 Temperature Rise and Dimensional Change of Bearing Steel

### 8.3.2 Interference Deviation Due to Temperature Rise (Aluminum Housing, Plastic Housing)

For reducing weight and cost or improving the performance of equipment, bearing housing materials such as aluminum, light alloys, or plastics (polyacetal resin, etc.) are often used. When non-ferrous materials are used in housings, any temperature rise occurring during operation affects the interference or clearance of the outer ring due to the difference in the coefficients of linear expansion. This change is large for plastics which have high coefficients of linear expansion. The deviation $\Delta D_T$ of clearance or interference of a fitting surface of a bearing's outer ring due to temperature rise is expressed by the following equation:

$$\Delta D_T = (\alpha_1 \cdot \Delta T_1 - \alpha_2 \cdot \Delta T_2)D \text{ (mm)} \cdots\cdots (\mathbf{8.12})$$

where $\Delta D_T$: Change of clearance or interference at fitting surface due to temperature rise
$\alpha_1$: Coefficient of linear expansion of housing (1/°C)
$\Delta T_1$: Housing temperature rise near fitting surface (°C)
$\alpha_2$: Coefficient of linear expansion of bearing outer ring
Bearing steel .... $\alpha_2 = 12.5 \times 10^{-6}$ (1/°C)
$\Delta T_2$: Outer ring temperature rise near fitting surface (°C)
D: Bearing outside diameter (mm)

In general, the housing temperature rise and that of the outer ring are somewhat different, but if we assume they are approximately equal near the fitting surfaces, ($\Delta T_1 \fallingdotseq \Delta T_2 = \Delta T$), Equation (8.13) becomes,

$$\Delta D_T = (\alpha_1 - \alpha_2)\Delta T \cdot D \text{ (mm)} \cdots\cdots (\mathbf{8.13})$$

where $\Delta T$: Temperature rise of outer ring and housing near fitting surfaces (°C)

In the case of an aluminum housing ($\alpha_1 = 23.7 \times 10^{-6}$), Equation (8.13) can be shown graphically as in Fig. 8.10. Among the various plastics, polyacetal resin is one that is often used for bearing housings. The coefficients of linear expansion of plastics may vary or show directional characteristics. In the case of polyacetal resin, for molded products, it is approximately $9 \times 10^{-5}$. Equation (8.13) can be shown as in Fig. 8.11.

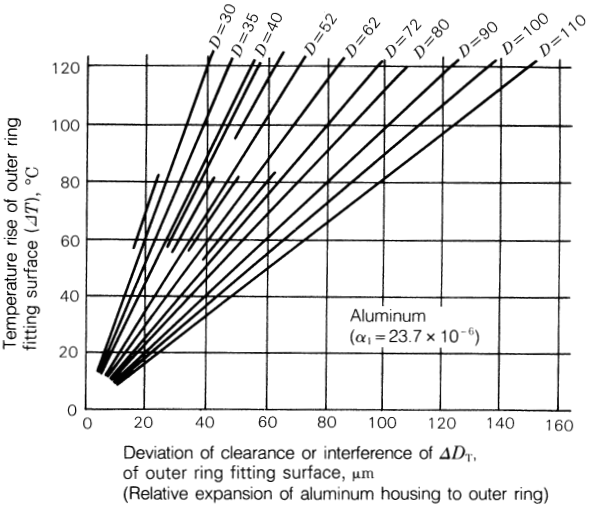



Fig. 8.10 Aluminum Housing

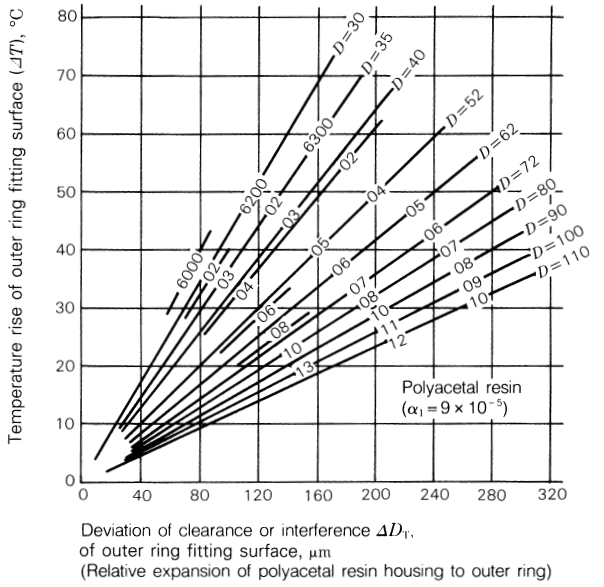



Fig. 8.11 Polyacetal Resin Housing

### 8.3.3 Calculating Residual Internal Clearance After Mounting

The various types of internal bearing clearance were discussed in Section 8.2.2. This section will explain the step by step procedures for calculating residual internal clearance. When the inner ring of a bearing is press fit onto a shaft, or when the outer ring is press fit into a housing, it stands to reason that radial internal clearance will decrease due to the resulting expansion or contraction of the bearing raceways. Generally, most bearing applications have a rotating shaft which requires a tight fit between the inner ring and shaft and a loose fit between the outer ring and housing. Generally, therefore, only the effect of the interference on the inner ring needs to be taken into account. Below we have selected a 6310 single row deep groove ball bearing for our representative calculations. The shaft is set at k5, with the housing set at H7. An interference fit is applied only to the inner ring. Shaft diameter, bore size and radial clearance are the standard bearing measurements. Assuming that 99.7% of the parts are within tolerance, the mean value ($m_{\Delta f}$) and standard deviation ($\sigma_{\Delta f}$) of the internal clearance after mounting (residual clearance) can be calculated. Measurements are given in units of millimeters (mm).

$$\sigma_s = \frac{R_s/2}{3} = 0.0018$$

$$\sigma_i = \frac{R_i/2}{3} = 0.0020$$

$$\sigma_{\Delta 0} = \frac{R_{\Delta 0}/2}{3} = 0.0028$$

$$\sigma_f^2 = \sigma_s^2 + \sigma_i^2$$

$$m_{\Delta f} = m_{\Delta 0} - \lambda_i (m_s - m_i) = 0.0035$$

$$\sigma_{\Delta f} = \sqrt{\sigma_{\Delta 0}^2 + \lambda_i^2 \sigma_i^2} = 0.0035$$

where
- $\sigma_s$: Standard deviation of shaft diameter
- $\sigma_i$: Standard deviation of bore diameter
- $\sigma_f$: Standard deviation of interference
- $\sigma_{\Delta 0}$: Standard deviation of radial clearance (before mounting)
- $\sigma_{\Delta f}$: Standard deviation of residual clearance (after mounting)
- $m_s$: Mean value of shaft diameter ($\phi$50 + 0.008)
- $m_i$: Mean value of bore diameter ($\phi$50 – 0.006)
- $m_{\Delta 0}$: Mean value of radial clearance (0.014)
- $m_{\Delta f}$: Mean value of residual clearance (after mounting)
- $R_s$: Shaft tolerance (0.011)
- $R_i$: Bearing bore tolerance (0.012)
- $R_{\Delta 0}$: Range in radial clearance (before mounting) (0.017)
- $\lambda_i$: Rate of raceway expansion from apparent interference (0.75 from Fig. 8.12)

The average amount of raceway expansion and contraction from apparent interference is calculated from $\lambda_i$ ($m_m - m_i$). To determine, wihtin a 99.7% probability, the variation in internal clearance after mounting ($R_{\Delta f}$), we use the following equation.

$$R_{\Delta f} = m_{\Delta f} \pm 3\sigma_{\Delta f} = +0.014 \text{ to } -0.007$$

In other words, the mean value of residual clearance ($m_{\Delta f}$) is +0.0035, and the range is from –0.007 to +0.014 for a 6310 bearing.

Units : µm

| | |
|---|---|
| Shaft diameter | $\phi 50\ ^{+0.013}_{+0.002}$ |
| Bearing bore diameter, (d) | $\phi 50\ ^{0}_{-0.012}$ |
| Radial internal clearance ($_{\Delta 0}$) | 0.006 to 0.023(1) |

**Note** (1)Standard internal clearance, unmounted

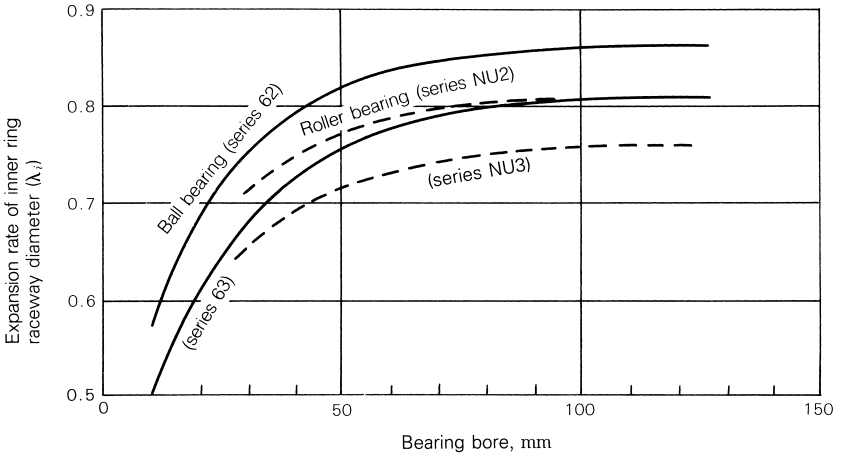



Fig. 8.12 Rate of Inner Ring Raceway Expansion ($\lambda_i$) from Apparent Interference



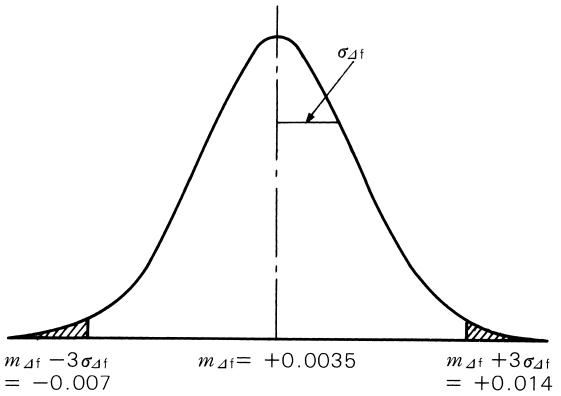



Fig. 8.13 Distribution of Residual Internal Clearance

### 8.3.4 Effect of Interference Fit on Bearing Raceways (Fit of Inner Ring)

One of the important factors that relates to radial clearance is the reduction in radial clearance resulting from the mounting fit. When inner ring is mounted on a shaft with an interference fit and the outer ring is secured in a housing with an interference fit, the inner ring will expand and the outer ring will contract. The means of calculating the amount of ring expansion or contraction were previously noted in Section 8.1.2 (5), however, the equation for establishing the amount of inner raceway expansion ($\Delta D_i$) is given in Equation (8.14).

$$\Delta D_i = \Delta d\, k \frac{1 - k_0^2}{1 - k^2 k_0^2} \quad \cdots\cdots (\mathbf{8.14})$$

where $\Delta d$: Effective interference (mm)
$k$: Ratio of bore to inner raceway diameter; $k=d/D_i$
$k_0$: Ratio of inside to outside diameter of hollow shaft; $k_0=d_0/D_i$
$d$: Bore or shaft diameter (mm)
$D_i$: Inner raceway diameter (mm)
$d_0$: Inside diameter of hollow shaft (mm)

Equation (8.14) has been translated into a clearer graphical form in Fig. 8.14. The vertical axis of Fig. 8.14 represents the inner raceway diameter expansion in relation to the amount of interference. The horizontal axis is the ratio of inside and outside diameter of the hollow shaft ($k_0$) and uses as its parameter the ratio of bore diameter and raceway diameter of the inner ring (k). Generally, the decrease in radial clearance is calculated to be approximately 80% of the interference. However, this is for solid shaft mountings only. For hollow shaft mountings the decrease in radial clearance varies with the ratio of inside to outside diameter of the shaft. Since the general 80% rule is based on average bearing bore size to inner raceway diameter ratios, the change will vary with different bearing types, sizes, and series. Typical plots for Single Row Deep Groove Ball Bearings and for Cylindrical Roller Bearings are shown in Figs. 8.15 and 8.16. Values in Fig. 8.14 apply only for steel shafts. Let's take as an example a 6220 ball bearing mounted on a hollow shaft (diameter d=100 mm, inside diameter d0=65 mm) with a fit class of m5 and determine the decrease in radial clearance. The ratio between bore diameter and raceway diameter, k is 0.87 as shown in Fig. 8.15. The ratio of inside to outside diameter for shaft, $k_0$, is $k_0=d_0 / d=0.65$. Thus, reading from Fig. 8.14, the rate of raceway expansion is 73%. Given that an interference of m5 has a mean value of 30 µm, the amount of raceway expansion, or, the amount of decrease in the radial clearance from the fit is $0.73 \times 30 = 22$ µm.

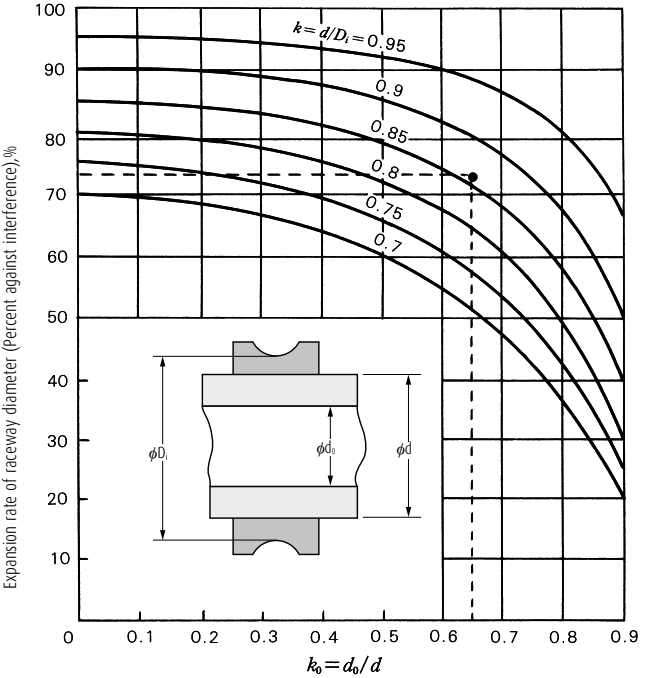



Fig. 8.14 Raceway Expansion in Relation to Bearing Fit (Inner Ring Fit upon Steel Shaft)

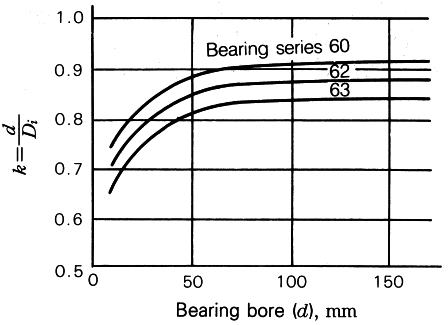



Fig. 8.15 Ratio of Bore Size to Raceway Diameter for Single Row Deep Groove Ball Bearings

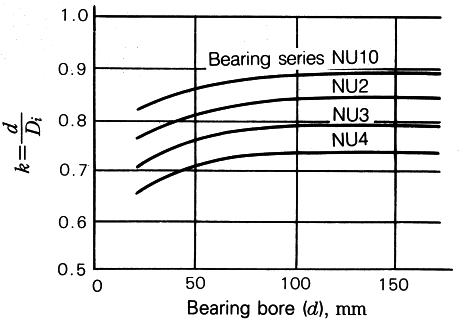



Fig. 8.16 Ratio of Bore Size to Raceway Diameter for Cylindrical Roller Bearings

### 8.3.5 Effect of Interference Fit on Bearing Raceways (Fit of Outer Ring)

We continue with the calculation of the raceway contraction of the outer ring after fitting. When a bearing load is applied on a rotating inner ring (outer ring carrying a static load), an interference fit is adopted for the inner ring and the outer ring is mounted either with a transition fit or a clearance fit. However, when the bearing load is applied on a rotating outer ring (inner ring carrying a static load) or when there is an indeterminate load and the outer ring must be mounted with an interference fit, a decrease in radial internal clearance caused by the fit begins to contribute in the same way as when the inner ring is mounted with an interference fit. Actually, because the amount of interference that can be applied to the outer ring is limited by stress, and because the constraints of most bearing applications make it difficult to apply a large amount of interference to the outer ring, and instances where there is an indeterminate load are quite rare compared to those where a rotating inner ring carries the load, there are few occasions where it is necessary to be cautious about the decrease in radial clearance caused by outer-ring interference. The decrease in outer raceway diameter $\Delta D_e$ is calculated using Equation (8.15).

$$\Delta D_e = \Delta d \cdot h \frac{1 - h_0^2}{1 - h^2 h_0^2} \quad \cdots\cdots (\mathbf{8.15})$$

where $\Delta D$: Effective interference (mm)
$h$: Ratio between raceway dia. and outside dia. of outer ring, $h=D_e/D$
$h_0$: Housing thickness ratio, $h_0=D/D_0$
$D$: Bearing outside diameter (housing bore diameter) (mm)
$D_e$: Raceway diameter of outer ring (mm)
$D_0$: Outside diameter of housing (mm)

Fig. 8.17 represents the above equation in graphic form. The vertical axis show the outer-ring raceway contraction as a percentage of interference, and the horizontal axis is the housing thickness ratio $h_0$. The data are plotted for constant values of the outer-ring thickness ratio from 0.7 through 1.0 in increments of 0.05. The value of thickness ratio h will differ with bearing type, size, and diameter series. Representative values for single-row deep groove ball bearings and for cylindrical roller bearings are given in Figs. 8.18 and 8.19 respectively.

Loads applied on rotating outer rings occur in such applications as automotive front axles, tension pulleys, conveyor systems, and other pulley systems. As an example, we estimate the amount of decrease in radial clearance assuming a 6207 ball bearing is mounted in a steel housing with an N7 fit. The outside diameter of the housing is assumed to be $D_0$=95, and the bearing outside diameter is D=72. From Fig. 8.18, the outer-ring thickness ratio, h, is 0.9. Because $h_0=D/D_0$ =0.76, from Fig. 8.17, the amount of raceway contraction is 71%. Taking the mean value for N7 interference as 18 µm, the amount of contraction of the outer raceway, or the amount of decrease in radial clearance is $0.71 \times 18 = 13$ µm.

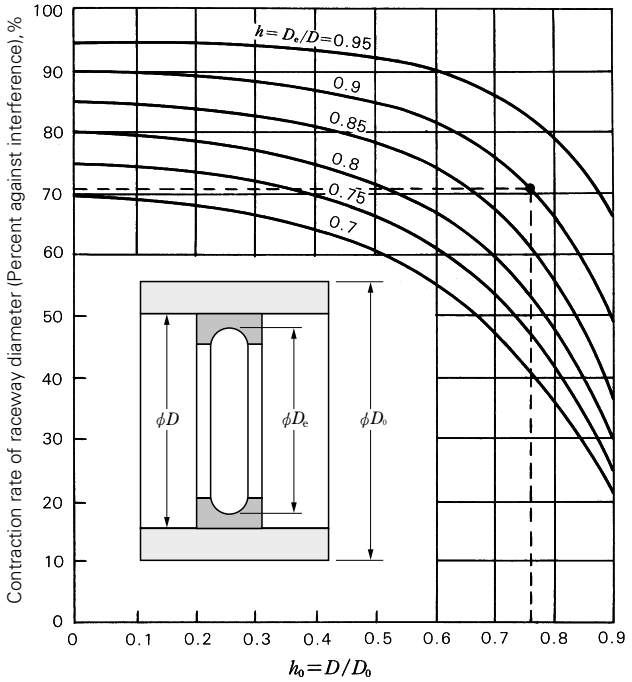



Fig. 8.17 Raceway Contraction in Relation to Bearing Fit (Outer Ring Fit in Steel Housing)

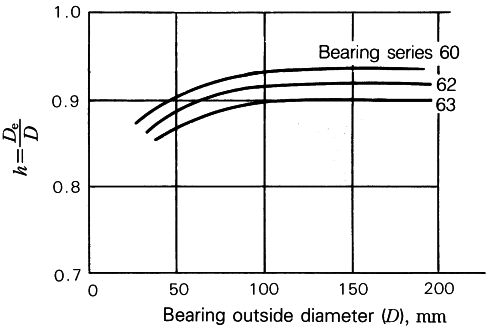



Fig. 8.18 Ratio of Outside Diameter to Raceway Diameter for Single Row Deep Groove Ball Bearings

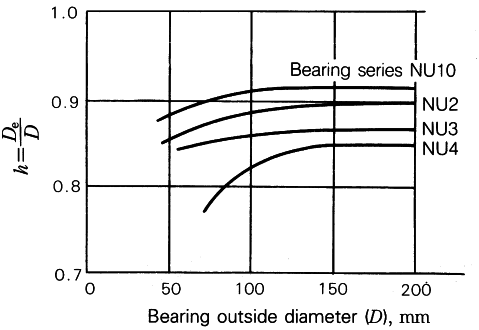



Fig. 8.19 Ratio of Outside Diameter to Raceway Diameter for Cylindrical Roller Bearings

### 8.3.6 Measuring Method of Internal Clearance of Combined Tapered Roller Bearings (Offset Measuring Method)

Combined tapered roller bearings are available in two types: a back-to-back combination (DB type) and a face-to-face combination (DF type) (see Fig. 8.20 and Fig. 8.21).
The advantages of these combinations can be obtained by assembly as one set or combined with other bearings to be a fixed- or free-side bearing. For the DB type of combined tapered roller bearing, as its cage protrudes from the back side of the outer ring, the outer ring spacer (K spacer in Fig. 8.20) is mounted to prevent mutual contact of cages. For the inner ring, the inner ring spacer (L spacer in Fig. 8.20), having an appropriate width, is provided to secure the clearance. For the DF type, as shown in Fig. 8.21, bearings are used with a K spacer.
In general, to use such a bearing arrangement either an appropriate clearance is required that takes into account the heat generated during operation or an applied preload is required that increases the rigidity of the bearings. The spacer width should be adjusted so as to provide an appropriate clearance or preload (minus clearance) after mounting. Hereunder, we introduce you to a clearance measurement method for a DB arrangement.

(1) As shown in Fig. 8.22, put the bearing A on the surface plate and after stabilization of rollers by rotating the outer ring (more than 10 turns), measure the offset $f_A = T_A - B_A$.

(2) Next, as shown in Fig. 8.23, use the same procedure to measure the other bearing B for its offset $f_B = T_B - B_B$.

(3) Next, measure the width of the K and L spacers as shown in Fig. 8.24.

From the results of the above measurements, the axial clearance $\Delta_a$ of the combined tapered roller bearing can be obtained, with the use of symbols shown in Figs. 8.22 through 8.24 by Equation (8.16):

$$\Delta_a = (L - K) - (f_A + f_B) \quad \cdots\cdots (\mathbf{8.16})$$

As an example, for the combined tapered roller bearing HR32232JDB+KLR10AC3, confirm the clearance of the actual product conforms to the specifications. First, refer to Table 8.17 and notice that the C3 clearance range is $\Delta_r$ =110 to 140 μm. To compare this specification with the offset measurement results, convert it into an axial clearance $\Delta_a$ by using Equation (8.17):

$$\Delta_a = \Delta_r \cot\alpha \fallingdotseq \Delta_r \frac{1.5}{e} \quad \cdots\cdots (\mathbf{8.17})$$

where, e: Constant determined for each bearing No. (Listed in the Bearing Tables of NSK Rolling Bearings Catalog)

refering to the said catalog (Page B223), with use of e = 0.44, the following is obtained:

$$\Delta_a = (110 \text{ to } 140) \times \frac{1.5}{e} \fallingdotseq 380 \text{ to } 480 \ \mu m$$

It is possible to confirm that the bearing clearance is C3, by verifying that the axial clearance $\Delta_a$ of Equation (8.16) (obtained by the bearing offset measurement) is within the above mentioned range.

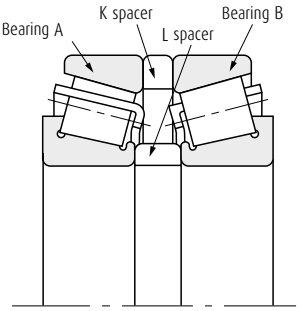



Fig. 8.20 DB Arrangement

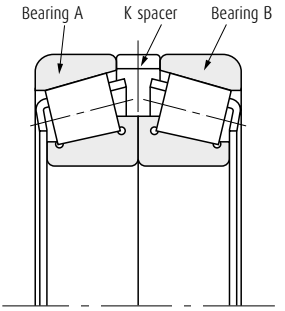



Fig. 8.21 DF Arrangement

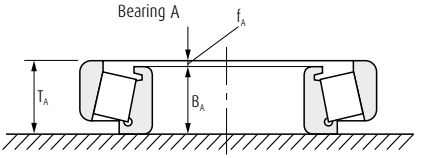



Fig. 8.22

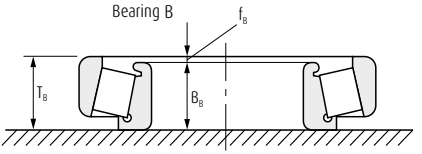



Fig. 8.23

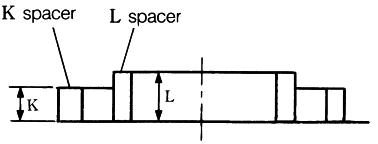



Fig. 8.24

### 8.3.7 Internal Clearance Adjustment Method when Mounting a Tapered Roller Bearing

The two single row tapered roller bearings are usually arranged in a configuration opposite each other and the clearance is adjusted in the axial direction. There are two types of opposite placement methods: back-to-back arrangement (DB arrangement) and face-to-face arrangement (DF arrangement). The clearance adjustment of the back-to-back arrangement is performed by tightening the inner ring by a shaft nut or a shaft end bolt. In Fig. 8.25, an example using a shaft end bolt is shown. In this case, it is necessary that the fit of the tightening side inner ring with the shaft be a loose fit to allow displacement of the inner ring in the axial direction.

For the face-to-face arrangement, a shim is inserted between the cover, which retains the outer ring in the axial direction, and the housing in order to allow adjustment to the specified axial clearance (Fig. 8.26). In this case, it is necessary to use a loose fit between the tightening side of the outer ring and the housing in order to allow appropriate displacement of the outer ring in the axial direction. When the structure is designed to install the outer ring into the retaining cover (Fig. 8.27), the above measure becomes unnecessary and both mounting and dismounting become easy.

Theoretically when the bearing clearance is slightly negative during operation, the fatigue life becomes the longest, but if the negative clearance becomes much bigger, then the fatigue life becomes very short and heat generation quickly increases. Thus, it is generally arranged that the clearance be slightly positive (a little bigger than zero) while operating. In consideration of the clearance reduction caused by temperature difference of inner and outer rings during operation and difference of thermal expansion of the shaft and housing in the axial direction, the bearing clearance after mounting should be decided. In practice, the clearance C1 or C2 is frequently adopted which is listed in Table 8.17.

In addition, the relationship between the radial clearance $\Delta_r$ and axial clearance $\Delta_a$ is as follows:

$$\Delta_a = \Delta_r \cot\alpha \fallingdotseq \Delta_r \frac{1.5}{e}$$

where, $\alpha$: Contact angle

e: Constant determined for each bearing No. (Listed in the Bearing Tables of NSK Rolling Bearing Catalog)

Tapered roller bearings, which are used for head spindles of machine tools, automotive final reduction gears, etc., are set to a negative clearance for the purpose of obtaining bearing rigidity. Such a method is called a preload method. There are two different modes of preloading: position preload and constant pressure preload. The position preload is used most often.

For the position preload, there are two methods: one method is to use an already adjusted arrangement of bearings and the other method is to apply the specified preload by tightening an adjustment nut or using an adjustment shim. The constant pressure preload is a method to apply an appropriate preload to the bearing by means of spring or hydraulic pressure, etc. Next we introduce several examples that use these methods:

Fig. 8.28 shows the automotive final reduction gear. For pinion gears, the preload is adjusted by use of an inner ring spacer and shim. For large gears on the other hand, the preload is controlled by tightening the torque of the outer ring retaining screw.

Fig. 8.29 shows the rear wheel of a truck. This is an example of a preload application by tightening the inner ring in the axial direction with a shaft nut. In this case, the preload is controlled by measuring the starting friction moment of the bearing.

Fig. 8.30 shows an example of the head spindle of the lathe, the preload is adjusted by tightening the shaft nut.

Fig. 8.31 shows an example of a constant pressure preload for which the preload is adjusted by the displacement of the spring. In this case, first find a relationship between the spring's preload and displacement, then use this information to establish a constant pressure preload.

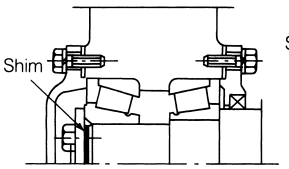



Fig. 8.25 DB Arrangement whose Clearance is Adjusted by Inner Rings.

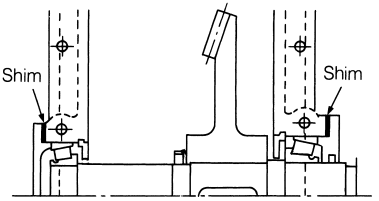



Fig. 8.26 DF Arrangement whose Clearance is Adjusted by Outer Rings.

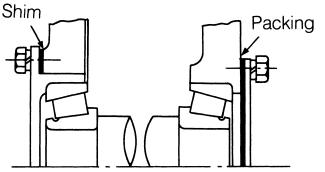



Fig. 8.27 Examples of Clearance Adjusted by Shim Thickness of Outer Ring Cover

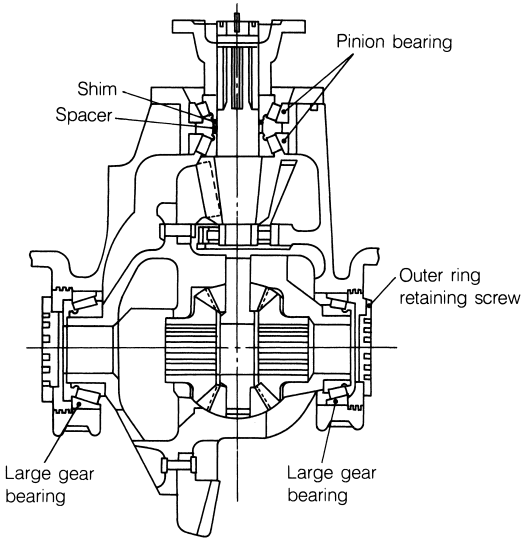



Fig. 8.28 Automotive Final Reduction Gear

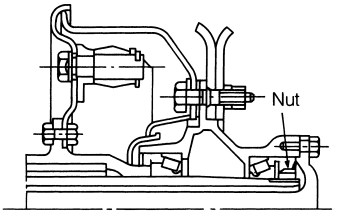



Fig. 8.29 Rear Wheel of Truck

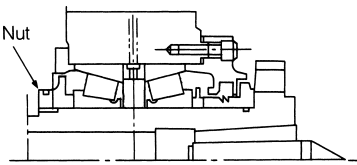



Fig. 8.30 Head Spindle of Lathe

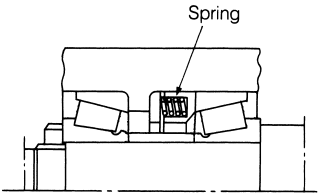
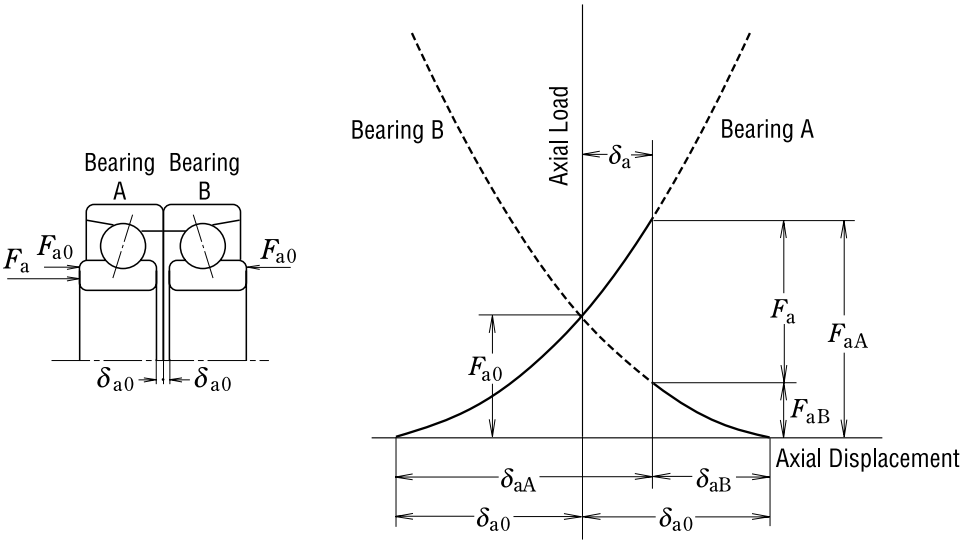



Fig. 8.31 Constant Pressure Preload Applied by Spring


Bearing A
Bearing B
$F_a$
$F_{a0}$
$F_{a0}$
$\delta_{a0}$
$\delta_{a0}$
Axial Load
Bearing B
Bearing A
$\delta_a$
$F_a$
$F_{aA}$
$F_{a0}$
$F_{aB}$
Axial Displacement
$\delta_{aA}$
$\delta_{aB}$
$\delta_{a0}$
$\delta_{a0}$

## 9. PRELOAD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Rolling bearings usually retain some internal clearance while in operation. In some cases, however, it is desirable to provide a negative clearance to keep them internally stressed. This is called "preloading". A preload is usually applied to bearings in which the clearance can be adjusted during mounting, such as angular contact ball bearings or tapered roller bearings. Usually, two bearings are mounted face-to-face or back-to-back to form a duplex set with a preload.

## 9.1 Purpose of Preload

The main purposes and some typical applications of preloaded bearings are as follows:

(1) To maintain the bearings in exact position both radially and axially and to maintain the running accuracy of the shaft.
...Main shafts of machine tools, precision instruments, etc.

(2) To increase bearing rigidity
...Main shafts of machine tools, pinion shafts of final drive gears of automobiles, etc.

(3) To minimize noise due to axial vibration and resonance
...Small electric motors, etc.

(4) To prevent sliding between the rolling elements and raceways due to gyroscopic moments
...High speed or high acceleration applications of angular contact ball bearings, and thrust ball bearings

(5) To maintain the rolling elements in their proper position with the bearing rings
...Thrust ball bearings and spherical thrust roller bearings mounted on a horizontal shaft

## 9.2 Preloading Methods

### 9.2.1 Position Preload

A position preload is achieved by fixing two axially opposed bearings in such a way that a preload is imposed on them. Their position, once fixed, remain unchanged while in operation.

In practice, the following three methods are generally used to obtain a position preload.

(1) By installing a duplex bearing set with previously adjusted stand-out dimensions (see Page A007 Fig. 1.1) and axial clearance.

(2) By using a spacer or shim of proper size to obtain the required spacing and preload. (Refer to Fig. 9.1)

(3) By utilizing bolts or nuts to allow adjustment of the axial preload. In this case, the starting torque should be measured to verify the proper preload.

### 9.2.2 Constant-Pressure Preload

A constant pressure preload is achieved using a coil or leaf spring to impose a constant preload. Even if the relative position of the bearings changes during operation, the magnitude of the preload remains relatively constant (refer to Fig. 9.2)

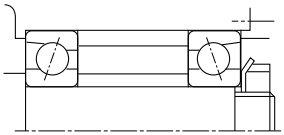


Fig. 9.1 Position Preload

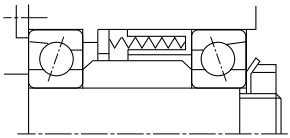


Fig. 9.2 Constant-Pressure Preload

## 9.3 Preload and Rigidity

### 9.3.1 Position Preload and Rigidity

When the inner rings of the duplex bearings shown in Fig. 9.3 are fixed axially, bearings A and B are displaced $\delta_{a0}$ and axial space $2\delta_{a0}$ between the inner rings is eliminated. With this condition, a preload $F_{a0}$ is imposed on each bearing. A preload diagram showing bearing rigidity, that is the relation between load and displacement with a given axial load $F_a$ imposed on a duplex set, is shown in Fig. 9.4.

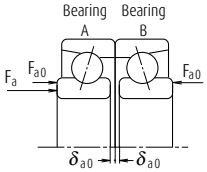



Fig. 9.3 Back-to-Back Duplex Bearing Preload

### 9.3.2 Constant-Pressure Preload and Rigidity

A preload diagram for duplex bearings under a constant-pressure preload is shown in Fig. 9.5. The deflection curve of the spring is nearly parallel to the horizontal axis because the rigidity of springs is lower than that of the bearing. As a result, the rigidity under a constant-pressure preload is approximately equal to that for a single bearing with a preload $F_{a0}$ applied to it. Fig. 9.6 presents a comparison of the rigidity of a bearing with a position preload and one with a constant-pressure preload.

## 9.4 Selection of Preloading Method and Amount of Preload

### 9.4.1 Comparison of Preloading Methods

A comparison of the rigidity using both preloading methods is shown in Fig. 9.6. The position preload and constant-pressure preload may be compared as follows:

(1) When both of the preloads are equal, the position preload provides greater bearing rigidity, in other words, the deflection due to external loads is less for bearings with a position preload.

(2) In the case of a position preload, the preload varies depending on such factors as a difference in axial expansion due to a temperature difference between the shaft and housing, a difference in radial expansion due to a temperature difference between the inner and outer rings, deflection due to load, etc.

In the case of a constant-pressure preload, it is possible to minimize any change in the preload because the variation of the spring load with shaft expansion and contraction is negligible. From the foregoing explanation, it is seen that position preloads are generally preferred for increasing rigidity and constant-pressure preloads are more suitable for high speed applications, for prevention of axial vibration, for use with thrust bearings on horizontal shafts, etc.

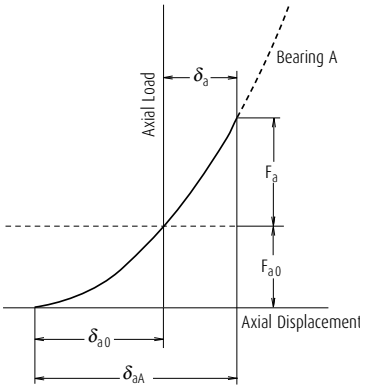
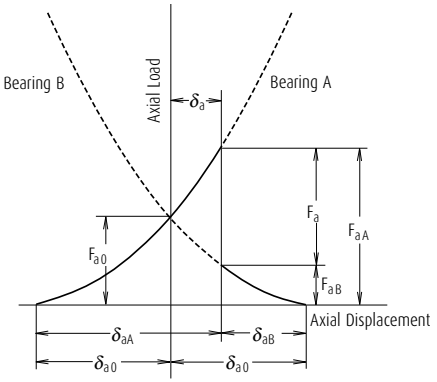



Fig. 9.5 Axial Displacement with Constant-Pressure Preload




$F_a$ : Axial load applied from outside
$F_{aA}$: Axial load imposed on Bearing A
$F_{aB}$: Axial load imposed on Bearing B

$\delta_a$ : Displacement of duplex bearing set
$\delta_{aA}$ : Displacement of Bearing A
$\delta_{aB}$ : Displacement of Bearing B

Fig. 9.4 Axial Displacement with Position Preload

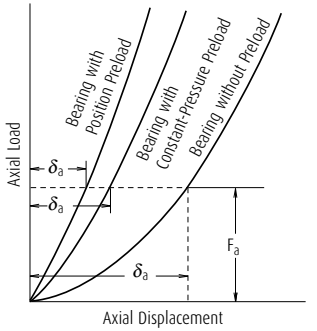



Fig. 9.6 Comparison of Rigidities and Preloading Methods

## 9.5 Amount of Preload

If the preload is larger than necessary, abnormal heart generation, increased frictional torque, reduced fatigue life, etc. may occur. The amount of the preload should be carefully determined considering the operating conditions and the purpose of the preload.

### 9.5.1 Average Preload for Duplex Angular Contact Ball Bearings

Angular contact ball bearings are widely used in spindles for grinding, milling, high-speed turning, etc. At NSK, preloads are divided into four graduated classifications — Extra light (EL), Light (L), Medium (M), and Heavy (H) — to allow the customer to freely choose the appropriate preload for the specific application. These four preload classes are expressed in symbols, EL, L, M, and H, respectively, when applied to DB and DF bearing sets.

The average preload and axial clearance (measured) for duplex angular contact ball bearing sets with contact angles 15° and 30° (widely used on machine tool spindles) are given in Tables 9.3 to 9.5. The measuring load when measuring axial clearance is shown in Table 9.1.
The recommended axial clearance to achieve the proper preload was determined for machine-tool spindles and other applications requiring ISO Class 5 and above high-precision bearing sets. The standard values given in Table 9.2 are used for the shaft — inner ring and housing — outer ring fits. The housing fits should be selected in the lower part of the standard clearance for bearings in fixed-end applications and the higher part of the standard clearance for bearings in free-end applications.

As general rules when selecting preloads, grinding machine spindles or machining center spindles require extra light to light preloads, whereas lathe spindles, which need rigidity, require medium preloads. The bearing preloads, if the bearing set is mounted with tight fit, are larger than those shown in Tables 9.3 to 9.5. Since excessive preloads cause bearing temperature rise and seizure, etc., it is necessary to pay attention to fitting. When speeds result in a value of $D_{pw} \times n$ ($d_m n$ value) higher than 500000, the preload should be very carefully studied and selected. In such a case, please consult with NSK beforehand.

### Table 9.1 Measuring Load of Axial Clearance

| Nominal bearing outside diameter D (mm) | | Measuring load |
|---|---|---|
| over | incl. | (N) |
| 10* | 50 | 24.5 |
| 50 | 120 | 49 |
| 120 | 200 | 98 |
| 200 | — | 196 |

*10 mm is included in this range.

### Table 9.2 Target of Fitting

Units : μm

| Bore or outside diameter d or D (mm) | | Shaft and inner ring | Housing and outer ring |
|---|---|---|---|
| over | incl. | Target interference | Target clearance |
| — | 18 | 0 to 2 | — |
| 18 | 30 | 0 to 2.5 | 2 to 6 |
| 30 | 50 | 0 to 2.5 | 2 to 6 |
| 50 | 80 | 0 to 3 | 3 to 8 |
| 80 | 120 | 0 to 4 | 3 to 9 |
| 120 | 150 | — | 4 to 12 |
| 150 | 180 | — | 4 to 12 |
| 180 | 250 | — | 5 to 15 |

## Table 9.3 Average Preloads and Axial Clearance for Bearing Series 79C

| Bearing No. | Extra light EL | | Light L | | Medium M | | Heavy H | |
|---|---|---|---|---|---|---|---|---|
| | Preload | Axial clearance | Preload | Axial clearance | Preload | Axial clearance | Preload | Axial clearance |
| | (N) | (µm) | (N) | (µm) | (N) | (µm) | (N) | (µm) |
| **7900 C** | 7 | 5 | 16 | 2 | 29 | -1 | 58 | -6 |
| **7901 C** | 8.6 | 4 | 15 | 2 | 41 | -3 | 77 | -8 |
| **7902 C** | 12 | 3 | 25 | 0 | 47 | -4 | 104 | -11 |
| **7903 C** | 11 | 3 | 25 | 0 | 56 | -5 | 119 | -12 |
| **7904 C** | 20 | 1 | 42 | -3 | 80 | -8 | 152 | -15 |
| **7905 C** | 19 | 1 | 37 | -2 | 99 | -9 | 203 | -17 |
| **7906 C** | 25 | 0 | 46 | -3 | 95 | -8 | 204 | -16 |
| **7907 C** | 33 | 2 | 67 | -2 | 149 | -9 | 297 | -18 |
| **7908 C** | 41 | 1 | 78 | -3 | 196 | -12 | 384 | -22 |
| **7909 C** | 49 | 0 | 104 | -5 | 192 | -11 | 391 | -21 |
| **7910 C** | 49 | 0 | 95 | -4 | 240 | -13 | 499 | -24 |
| **7911 C** | 60 | -1 | 111 | -5 | 296 | -15 | 593 | -26 |
| **7912 C** | 60 | -1 | 113 | -5 | 305 | -15 | 581 | -25 |
| **7913 C** | 74 | -2 | 151 | -7 | 348 | -16 | 690 | -27 |
| **7914 C** | 101 | -4 | 205 | -10 | 503 | -22 | 1 004 | -36 |
| **7915 C** | 103 | -4 | 190 | -9 | 489 | -21 | 997 | -35 |
| **7916 C** | 104 | -4 | 195 | -9 | 503 | -21 | 986 | -34 |
| **7917 C** | 138 | -6 | 307 | -14 | 629 | -25 | 1 281 | -41 |
| **7918 C** | 153 | -3 | 289 | -9 | 740 | -23 | 1 488 | -39 |
| **7919 C** | 154 | -3 | 294 | -9 | 800 | -24 | 1 588 | -40 |
| **7920 C** | 191 | -5 | 387 | -13 | 905 | -28 | 1 790 | -46 |

**Remark** In the axial clearance column, the measured value is given.

## Table 9.4 Average Preloads and Axial Clearance for Bearing Series 70C

| Bearing No. | Extra light EL | | Light L | | Medium M | | Heavy H | |
|---|---|---|---|---|---|---|---|---|
| | Preload | Axial clearance | Preload | Axial clearance | Preload | Axial clearance | Preload | Axial clearance |
| | (N) | (µm) | (N) | (µm) | (N) | (µm) | (N) | (µm) |
| 7000 C | 13 | 3 | 25 | 0 | 49 | -5 | 96 | -12 |
| 7001 C | 13 | 3 | 25 | 0 | 57 | -6 | 120 | -14 |
| 7002 C | 12 | 3 | 29 | -1 | 66 | -7 | 147 | -16 |
| 7003 C | 15 | 2 | 30 | -1 | 69 | -7 | 156 | -16 |
| 7004 C | 25 | 0 | 49 | -4 | 119 | -12 | 244 | -22 |
| 7005 C | 30 | -1 | 58 | -5 | 148 | -14 | 292 | -24 |
| 7006 C | 41 | 1 | 75 | -3 | 195 | -13 | 386 | -24 |
| 7007 C | 58 | -1 | 121 | -7 | 251 | -16 | 493 | -28 |
| 7008 C | 58 | -1 | 114 | -6 | 291 | -17 | 594 | -30 |
| 7009 C | 80 | -3 | 144 | -8 | 338 | -19 | 695 | -33 |
| 7010 C | 70 | -2 | 152 | -8 | 388 | -20 | 791 | -34 |
| 7011 C | 95 | -4 | 200 | -11 | 479 | -24 | 971 | -40 |
| 7012 C | 96 | -4 | 189 | -10 | 526 | -25 | 1 092 | -42 |
| 7013 C | 130 | -6 | 260 | -13 | 537 | -24 | 1 062 | -39 |
| 7014 C | 148 | -7 | 285 | -14 | 732 | -30 | 1 460 | -48 |
| 7015 C | 151 | -7 | 294 | -14 | 796 | -31 | 1 573 | -49 |
| 7016 C | 202 | -6 | 382 | -14 | 921 | -31 | 1 880 | -52 |
| 7017 C | 205 | -6 | 393 | -14 | 995 | -32 | 1 956 | -52 |
| 7018 C | 247 | -8 | 502 | -18 | 1 187 | -37 | 2 373 | -60 |
| 7019 C | 275 | -9 | 549 | -19 | 1 188 | -36 | 2 348 | -58 |
| 7020 C | 282 | -9 | 534 | -18 | 1 278 | -37 | 2 572 | -60 |

**Remark** In the axial clearance column, the measured value is given.

## Table 9.5 Average Preloads and Axial Clearance for Bearing Series 72C

| Bearing No. | Extra light EL | | Light L | | Medium M | | Heavy H | |
|---|---|---|---|---|---|---|---|---|
| | Preload | Axial clearance | Preload | Axial clearance | Preload | Axial clearance | Preload | Axial clearance |
| | (N) | (µm) | (N) | (µm) | (N) | (µm) | (N) | (µm) |
| **7200 C** | 13 | 3 | 29 | -1 | 68 | -8 | 150 | -18 |
| **7201 C** | 20 | 1 | 39 | -3 | 99 | -12 | 197 | -22 |
| **7202 C** | 20 | 1 | 40 | -3 | 97 | -11 | 199 | -21 |
| **7203 C** | 25 | 0 | 46 | -4 | 146 | -16 | 296 | -28 |
| **7204 C** | 35 | -2 | 68 | -7 | 196 | -20 | 384 | -33 |
| **7205 C** | 42 | 1 | 82 | -4 | 193 | -14 | 402 | -27 |
| **7206 C** | 57 | -1 | 114 | -7 | 292 | -20 | 591 | -35 |
| **7207 C** | 75 | -3 | 151 | -10 | 385 | -25 | 794 | -43 |
| **7208 C** | 98 | -5 | 202 | -13 | 501 | -29 | 985 | -47 |
| **7209 C** | 123 | -7 | 254 | -16 | 534 | -30 | 1 067 | -49 |
| **7210 C** | 127 | -7 | 248 | -15 | 590 | -31 | 1 171 | -50 |
| **7211 C** | 142 | -8 | 289 | -17 | 788 | -38 | 1 554 | -60 |
| **7212 C** | 190 | -11 | 397 | -22 | 928 | -42 | 1 878 | -67 |
| **7213 C** | 219 | -12 | 448 | -23 | 1 069 | -44 | 2 175 | -70 |
| **7214 C** | 243 | -9 | 484 | -20 | 1 164 | -42 | 2 368 | -69 |
| **7215 C** | 270 | -10 | 530 | -21 | 1 224 | -42 | 2 445 | -68 |
| **7216 C** | 305 | -12 | 595 | -24 | 1 367 | -47 | 2 752 | -76 |
| **7217 C** | 355 | -14 | 697 | -27 | 1 658 | -53 | 3 358 | -85 |
| **7218 C** | 384 | -15 | 771 | -29 | 1 865 | -57 | 3 713 | -90 |
| **7219 C** | 448 | -18 | 876 | -33 | 2 081 | -63 | 4 153 | -99 |
| **7220 C** | 503 | -20 | 984 | -36 | 2 337 | -68 | 4 700 | -107 |

**Remark** In the axial clearance column, the measured value is given.

### 9.5.2 Preload of Thrust Ball Bearings

When the balls in thrust ball bearings rotate at relatively high speeds, sliding due to gyroscopic moments on the balls may occur. The larger of the two values obtained from Equations (9.1) and (9.2) below should be adopted as the minimum axial load in order to prevent such sliding

$$F_{a\,min} = \frac{C_{0a}}{100}\left(\frac{n}{N_{max}}\right)^2 \quad \cdots\cdots (\mathbf{9.1})$$

$$F_{a\,min} = \frac{C_{0a}}{1000} \quad \cdots\cdots (\mathbf{9.2})$$

where $F_{a\,min}$ : Minimum axial load (N), {kgf}

$n$ : Speed ($min^{-1}$)

$C_{0a}$ : Basic static load rating (N), {kgf}

$N_{max}$ : Limiting speed (oil lubrication) ($min^{-1}$)

### 9.5.3 Preload of Spherical Thrust Roller Bearings

When spherical thrust roller bearings are used, damage such as scoring may occur due to sliding between the rollers and outer ring raceway. The minimum axial load $F_{a\,min}$ necessary to prevent such sliding is obtained from the following equation:

$$F_{a\,min} = \frac{C_{0a}}{1000} \quad \cdots\cdots (\mathbf{9.3})$$

## 9.6 Technical Data

### 9.6.1 Load and Displacement of Position-Preloaded Bearings

Two (or more) ball or tapered roller bearings mounted side by side as a set are termed duplex (or multiple) bearing sets. The bearings most often used in multiple arrangements are single-row angular contact ball bearings for machine tool spindles, since there is a requirement to reduce the bearing displacement under load as much as possible. There are various ways of assembling sets depending on the effect desired. Duplex angular contact bearings fall into three types of arrangements, Back-to-Back, with lines of force convergent on the bearing back faces, Face-to-Face, with lines of force convergent on the bearing front faces, and Tandem, with lines of force being parallel. The symbols for these are DB, DF, and DT arrangements respectively (Fig. 9.7).

DB and DF arrangement sets can take axial loads in either direction. Since the distance of the load centers of DB bearing set is longer than that of DF bearing set, they are widely used in applications where there is a moment. DT type sets can only take axial loads in one direction. However, because the two bearings share some load equally between them, a set can be used where the load in one direction is large.

By selecting the DB or DF bearing sets with the proper preloads which have already been adjusted to an appropriate range by the bearing manufacturer, the radial and axial displacements of the bearing inner and outer ring can be reduced as much as allowed by certain limits. However, the DT bearing set cannot be preloaded.
The amount of preload can be adjusted by changing clearance between bearings, $\delta_{a0}$, as shown in Figs. 9.9 to 9.11. Preloads are divided into four graduated classification — Extra light (EL), Light (L), Medium (M), and Heavy (H). Therefore, DB and DF bearing sets are often used for applications where shaft misalignments and displacements due to loads must be minimized.
Triplex sets are also available in three types (symbols: DBD, DFD, and DTD) of arrangements as shown in Fig. 9.8. Sets of four or five bearings can also be used depending on the application requirements. Duplex bearings are often used with a preload applied. Since the preload affects the rise in bearing temperature during operation, torque, bearing noise, and especially bearing life, it is extremely important to avoid applying an excessive preload. Generally, the axial displacement $\delta_a$ under an axial load $F_a$ for single-row angular contact ball bearings is calculated as follows,

$$\delta_a = c\, F_a^{2/3} \quad \cdots\cdots (\mathbf{9.4})$$

where, c: Constant depending on the bearing type and dimensions.

Fig. 9.9 shows the preload curves of duplex DB arrangement, and Figs. 9.10 and 9.11 show those for triplex DBD arrangement.
If the inner rings of the duplex bearing set in Fig. 9.9 are pressed axially, A-side and B-side bearings are deformed $\delta_{a0A}$ and $\delta_{a0B}$ respectively and the clearance (between the inner rings), $\delta_{a0}$, becomes zero. This condition means that the preload $F_{a0}$ is applied on the bearing set. If an external axial load Fa is applied on the preloaded bearing set from the A-side, then the A-side bearing will be deformed $\delta_{a1}$ additionally and the displacement of B-side bearing will be reduced to the same amount as the A-side bearing displacement $\delta_{a1}$. Therefore, the displacements of A- and B-side bearings are $\delta_{aA} = \delta_{a0A} + \delta_{a1}$ and $\delta_{aB} = \delta_{a0B} + \delta_{a1}$ respectively. That is, the load on A-side bearing including the preload is $(F_{a0} + F_a - F_a')$ and the B-side bearing is $(F_{a0} - F_a')$.

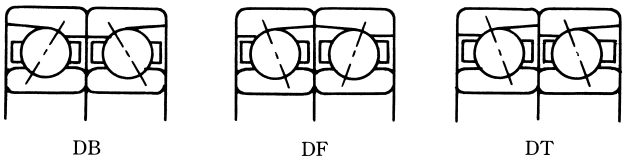



Fig. 9.7 Duplex Bearing Arrangements

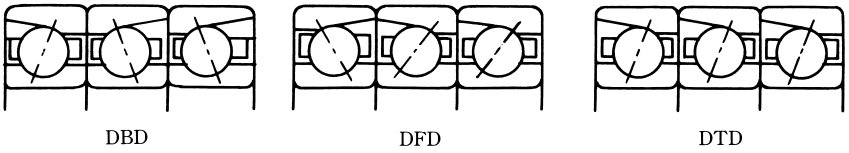



Fig. 9.8 Triplex Bearing Arrangements

9

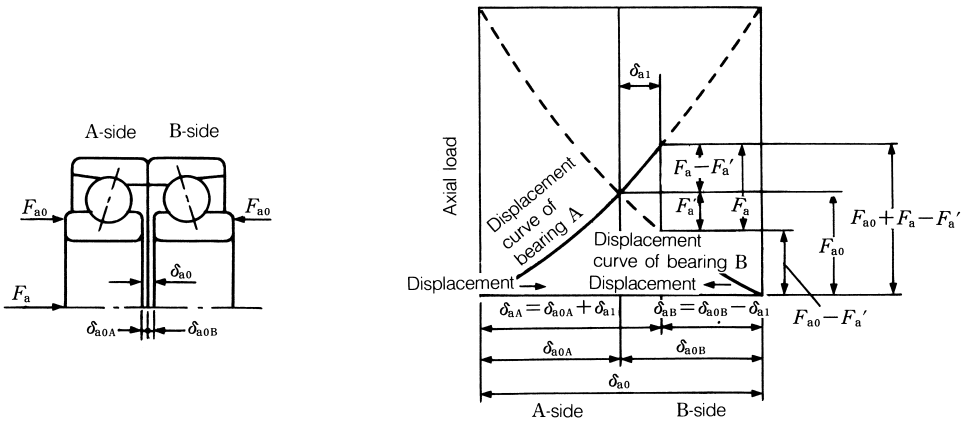



Fig. 9.9 Preload Graph of DB Arrangement Duplex Bearings

If the bearing set has an applied preload, the A-side bearing should have a sufficient life and load capacity for an axial load ($F_{a0} + F_a - F_a'$) under the speed condition. The axial clearance $\delta_{a0}$ is shown in Tables 9.3 to 9.5 of Section 9.5.1 (Pages A195 to A197).

In Fig. 9.10, with an external axial load $F_a$ applied on the AA-side bearings, the axial loads and displacements of AA- and B-side bearings are summarized in Table 9.6.

In Fig. 9.11, with an external axial load $F_a$ applied on the A-side bearing, the axial loads and displacements of A- and BB-side bearings are summarized in Table 9.7.

The examples, Figs. 9.12 to 9.17, show the relation of the axial loads and axial displacements using duplex DB and triplex DBD arrangements of 7018C and 7018A bearings under several preload ranges.

**Table 9.6**

| Direction | Displacement | Axial load |
|---|---|---|
| AA-side | $\delta_{a0A} + \delta_{a1}$ | $F_{a0} + F_a - F_a'$ |
| B-side | $\delta_{a0B} - \delta_{a1}$ | $F_{a0} - F_a'$ |

**Table 9.7**

| Direction | Displacement | Axial load |
|---|---|---|
| A-side | $\delta_{a0A} + \delta_{a1}$ | $F_{a0} + F_a - F_a'$ |
| BB-side | $\delta_{a0B} - \delta_{a1}$ | $F_{a0} - F_a'$ |

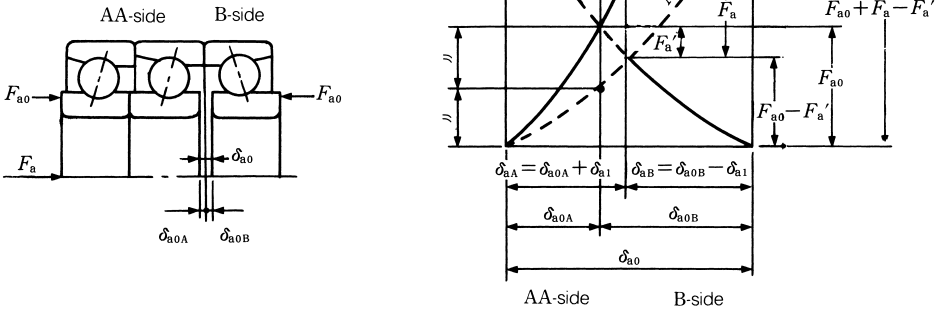



Fig. 9.10 Preload Graph of Triplex DBD Bearing Set (Axial load is applied from AA-side)

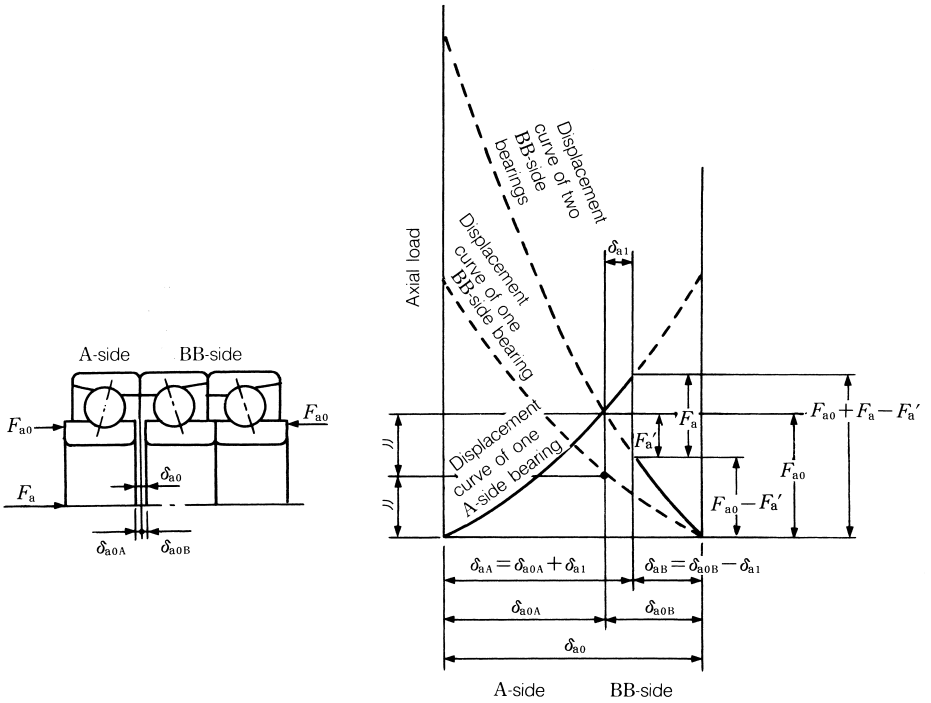



Fig. 9.11 Preload Graph of Triplex DBD Bearing set (Axial load is applied from A-side)

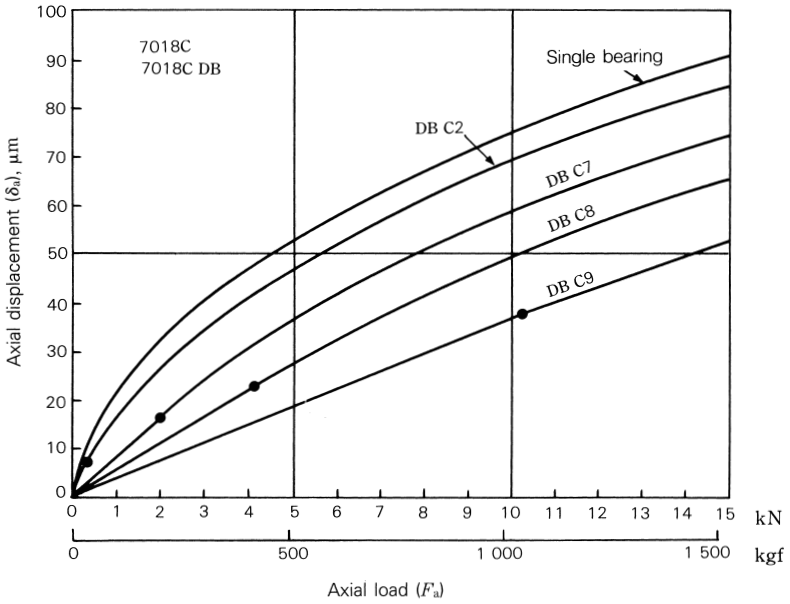



Fig. 9.12

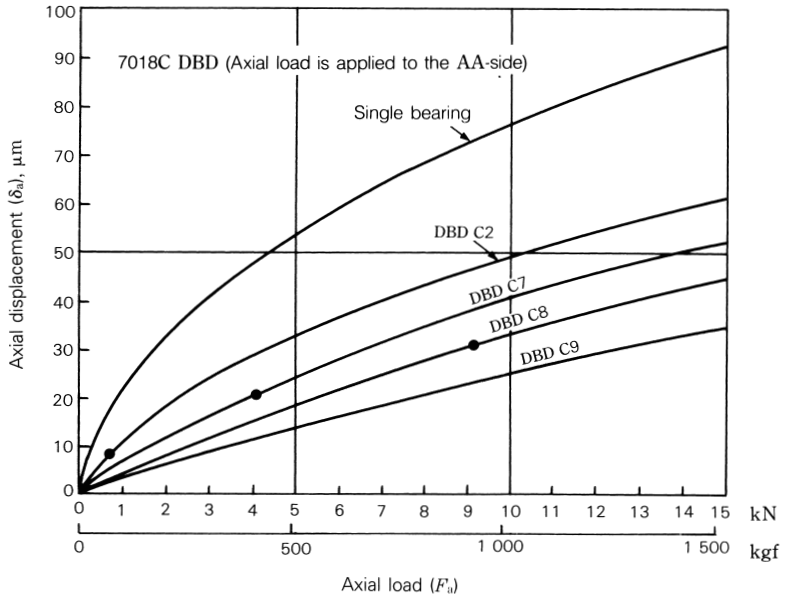



Fig. 9.13

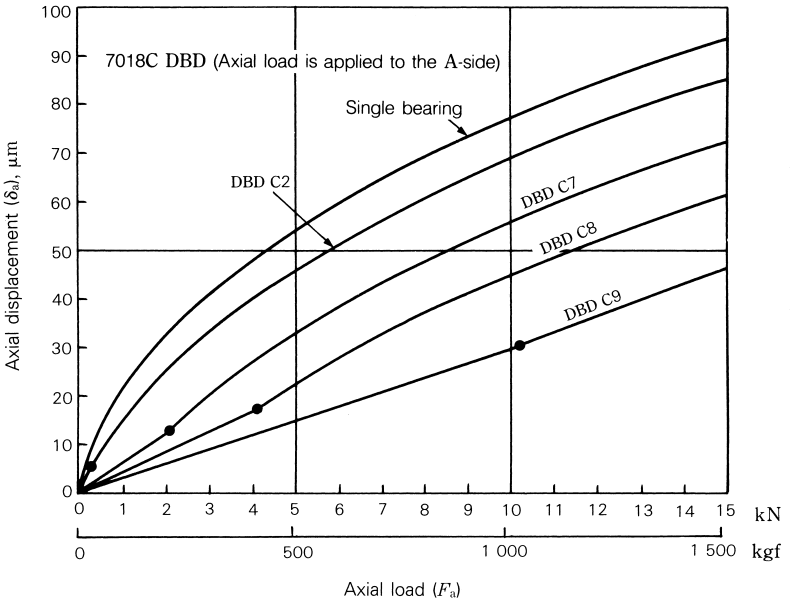



Fig. 9.14

**Remark** A (•) mark on the axial load or displacement curve indicates the point where the preload is zero. Therefore, if the axial load is larger than this, the opposed bearing does not impose a load.

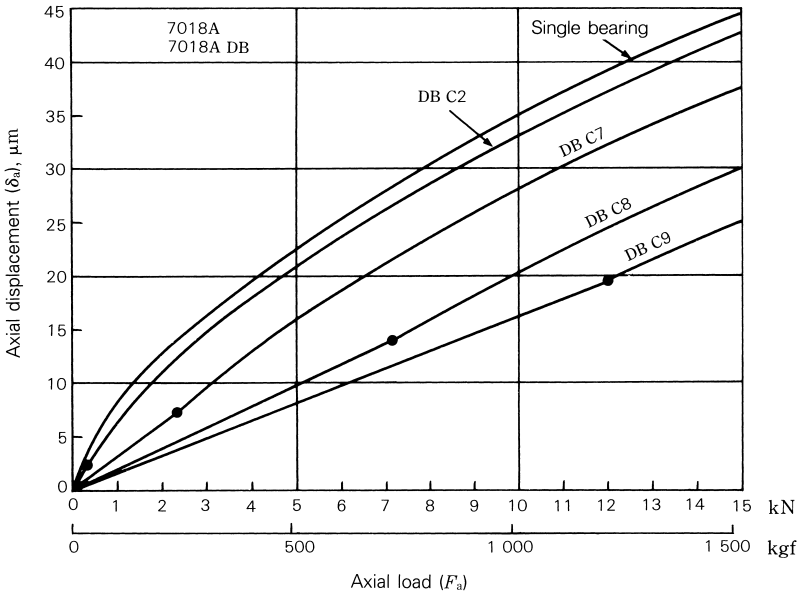



Fig. 9.15

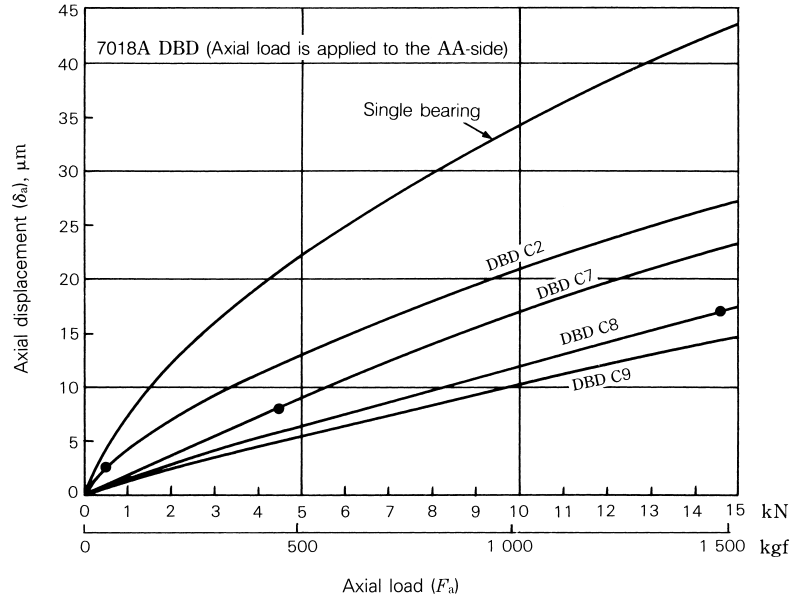



Fig. 9.16

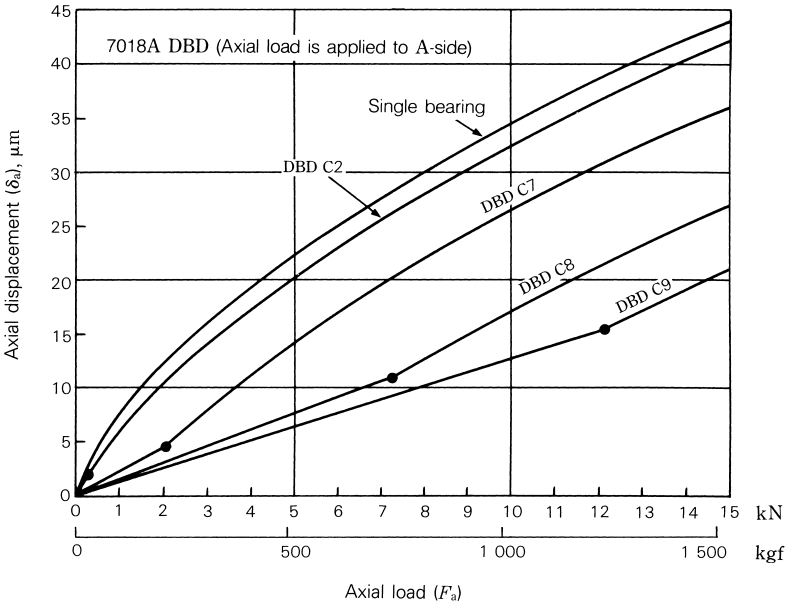



Fig. 9.17

**Remark** A (•) mark on the axial load or displacement curve indicates the point where the preload is zero. Therefore, if the axial load is larger than this, the opposed bearing does not impose a load.

9

### 9.6.2 Axial Displacement of Deep Groove Ball Bearings

When an axial load $F_a$ is applied to a radial bearing with a contact angle $\alpha_0$ and the inner ring is displaced $\delta_a$, the center Oi of the inner ring raceway radius is also moved to Oi' resulting in the contact angle $\alpha$ as shown in Fig. 9.18. If $\delta_N$ represents the elastic deformation of the raceway and ball in the direction of the rolling element load Q, Equation (9.5) is derived from Fig. 9.18.

$$(m_0 + d_N)^2 = (m_0 \cdot \sin\alpha_0 + \delta_a)^2 + (m_0 \cdot \cos\alpha_0)^2$$

$$\therefore\ \delta_N = m_0\left\{\sqrt{\left(\sin\alpha_0 + \frac{\delta_a}{m_0}\right)^2 + \cos^2\alpha_0} - 1\right\} \quad \cdots\cdots (9.5)$$

Also there is the following relationship between the rolling element load Q and elastic deformation $\delta_N$.

$$Q = K_N \cdot \delta_N^{3/2} \quad \cdots\cdots (9.6)$$

where, $K_N$: Constant depending on bearing material, type, and dimension

$\therefore$ If we introduce the relation of

$$m_0 = \left(\frac{r_e}{D_w} + \frac{r_i}{D_w} - 1\right) D_w = B \cdot D_w$$

Equations (9.5) and (9.6) are,

$$Q = K_N\ (B \cdot D_w)^{3/2}\left\{\sqrt{(\sin\alpha_0 + h)^2 + \cos^2\alpha_0} - 1\right\}^{3/2}$$

where, $h = \dfrac{\delta_a}{m_0} = \dfrac{\delta_a}{B \cdot D_w}$

If we introduce the relation of $K_N = K \cdot \dfrac{\sqrt{D_w}}{B^{3/2}}$

$$Q = K \cdot D_w^2\{\sqrt{(\sin\alpha_0 + h)^2 + \cos^2\alpha_0} - 1\}^{3/2} \quad \cdots\cdots (9.7)$$

On the other hand, the relation between the bearing axial load and rolling element load is shown in Equation (9.8) using Fig. 9.19:

$$F_a = Z \cdot Q \cdot \sin\alpha \quad \cdots\cdots (9.8)$$

Based on Fig. 9.18, we obtain,

$$(m_0 + \delta_N)\ \sin\alpha = m_0 \cdot \sin\alpha_0 + \delta_a$$

$$\therefore\ \sin\alpha = \frac{m_0 \cdot \sin\alpha_0 + \delta_a}{m_0 + \delta_N} = \frac{\sin\alpha_0 + h}{1 + \dfrac{\delta_N}{m_0}}$$

If we substitute Equation (9.5),

$$\sin\alpha = \frac{\sin\alpha_0 + h}{\sqrt{(\sin\alpha_0 + h)^2 + \cos^2\alpha_0}} \quad \cdots\cdots (9.9)$$

That is, the relation between the bearing axial load $F_a$ and axial displacement $\delta_a$ can be obtained by substituting Equations (9.7) and (9.9) for Equation (9.8).

$$F_a = K \cdot Z \cdot D_w^2 \cdot \frac{\{\sqrt{(\sin\alpha_0 + h)^2 + \cos^2\alpha_0} - 1\}^{3/2} \times (\sin\alpha_0 + h)}{\sqrt{(\sin\alpha_0 + h)^2 + \cos^2\alpha_0}} \quad \cdots\cdots (9.10)$$

where, K: Constant depending on the bearing material and design

$D_w$: Ball diameter

Z: Number of balls

$\alpha_0$: Initial contact angle

In case of single-row deep groove ball bearings, the initial contact angle can be obtained using Equation (5) of Page B012

$$\alpha = \cos^{-1}\left(\frac{r_e + r_i - D_w - \dfrac{\Delta_r}{2}}{r_e + r_i - D_w}\right) \quad \cdots\cdots (9.11)$$

$$= \sin^{-1}\left(\frac{\Delta_a/2}{r_e + r_i - D_w}\right) \quad \cdots\cdots (9.12)$$

Actual axial deformation varies depending on the bearing mounting conditions, such as the material and thickness of the shaft and housing, and bearing fitting. For details, consult with NSK regarding the axial deformation after mounting.

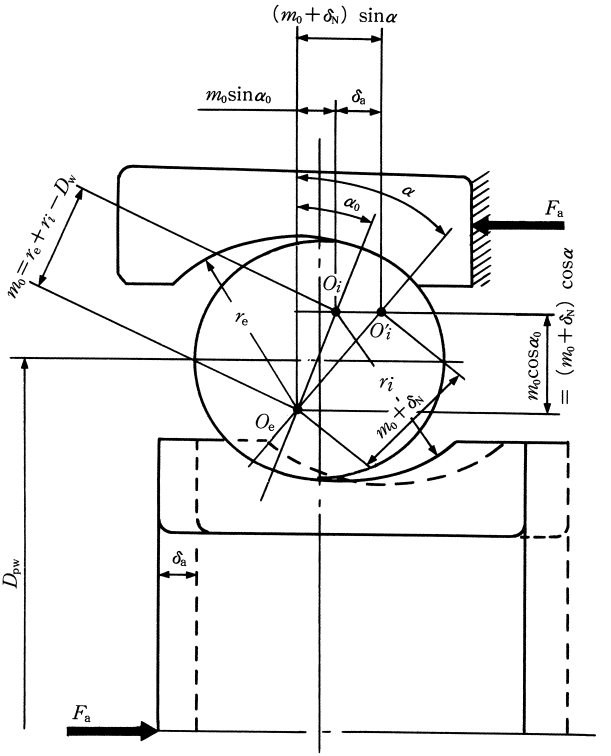



Fig. 9.18

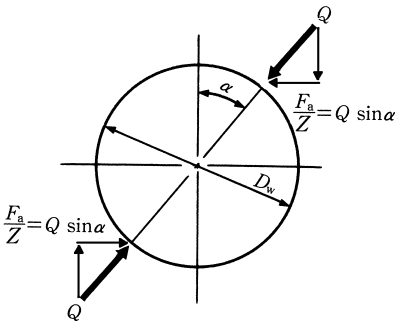



Fig. 9.19

Fig. 9.20 gives the relation between axial load and axial displacement for 6210 and 6310 single-row deep groove ball bearings with initial contact angles of $\alpha_0$=0°, 10°, 15°. The larger the initial contact angle $\alpha_0$, the more rigid the bearing will be in the axial direction and also the smaller the difference between the axial displacements of 6210 and 6310 under the same axial load. The angle $\alpha_0$ depends upon the groove radius and the radial clearance.

Fig. 9.21 gives the relation between axial load and axial displacement for 72 series angular contact ball bearings with initial contact angles of 15° (C), 30° (A), and 40° (B). Because 70 and 73 series bearings with identical contact angles and bore diameters can be considered to have almost the same values as 72 series bearings. Angular contact ball bearings that sustain loads in the axial direction must maintain their running accuracy and reduce the bearing elastic deformation from applied loads when used as multiple bearing sets with a preload applied.

To determine the preload to keep the elastic deformation caused by applied loads within the required limits, it is important to know the characteristics of load vs. deformation. The relationship between load and displacement can be expressed by Equation (9.10) as $F_a \propto \delta_a^{2/3}$ or $\delta_a \propto F_a^{2/3}$. That is, the axial displacement $\delta_a$ is proportional to the axial load $F_a$ to the 2/3 power. When this axial load index is less than one, it indicates the relative axial displacement will be small with only a small increase in the axial load. (Fig. 9.21) The underlying reason for applying a preload is to reduce the amount of displacement.

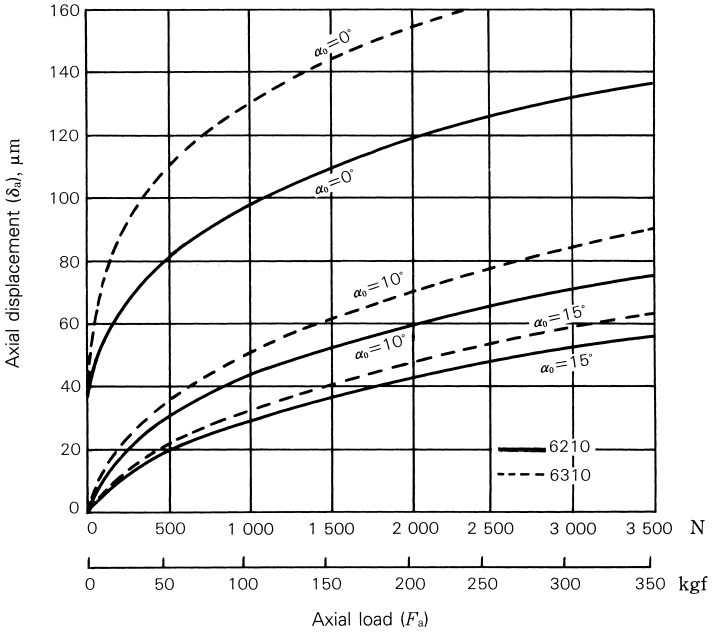



Fig. 9.20 Axial Load and Axial Displacement of Deep Groove Ball Bearings

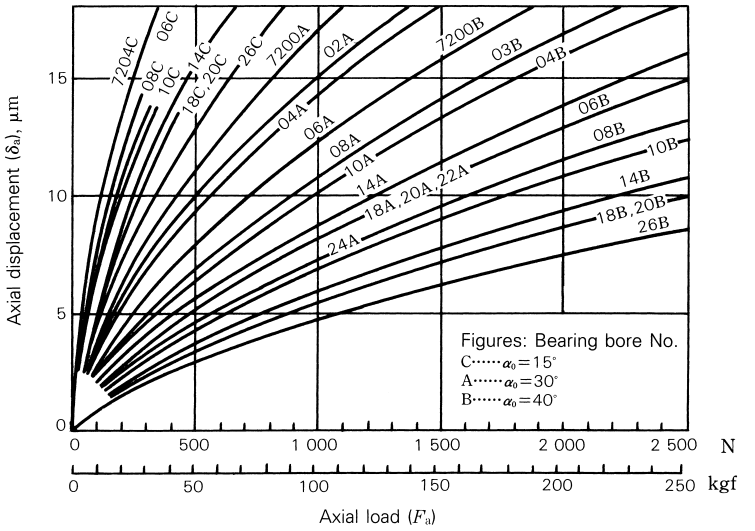



Fig. 9.21 Axial Load and Axial Displacement of Angular Contact Ball Bearings

### 9.6.3 Axial Displacement of Tapered Roller Bearings

Tapered roller bearings are widely used in pairs like angular contact ball bearings. Care should be taken to select appropriate tapered roller bearings. For example, the bearings of machine tool head spindles and automobile differential pinions are preloaded to increase shaft rigidity. When a bearing with an applied preload is to be used in an application, it is essential to have some knowledge of the relationship between axial load and axial displacement.
For tapered roller bearings, the axial displacement calculated using Palmgren's method, Equation (9.11) generally agrees well with actual measured values. Actual axial deformation varies depending on the bearing mounting conditions, such as the material and thickness of the shaft and housing, and bearing fitting. For details, consult with NSK regarding the axial deformation after mounting.

$$\left.\begin{aligned}\delta_a &= \frac{0.000077}{\sin\alpha}\cdot\frac{Q^{0.9}}{L_{we}{}^{0.8}} \quad (\mathrm{N})\\ &= \frac{0.0006}{\sin\alpha}\cdot\frac{Q^{0.9}}{L_{we}{}^{0.8}} \quad \{\mathrm{kgf}\}\end{aligned}\right\} \cdots\cdots (\mathbf{9.13})$$

where, $\delta_a$: Axial displacement of inner, outer ring (mm)
$\alpha$: Contact angle...1/2 the cup angle (°)
(Refer to Fig. 9.22)
Q: Load on rolling elements (N), {kgf}

$$Q = \frac{F_a}{Z\sin\alpha}$$

$L_{we}$: Length of effective contact on roller (mm)
$F_a$: Axial load (N), {kgf}
Z: Number of rollers

Equation (9.11) can also be expressed as Equation (9.12).

$$\delta_a = K_a \cdot F_a{}^{0.9} \cdots\cdots (\mathbf{9.14})$$

where,

$$K_a = \frac{0.000077}{(\sin\alpha)^{1.9}\, Z^{0.9}\, L_{we}{}^{0.8}} \cdots\cdots (\mathrm{N})$$

$$= \frac{0.0006}{(\sin\alpha)^{1.9}\, Z^{0.9}\, L_{we}{}^{0.8}} \cdots\cdots \{\mathrm{kgf}\}$$

Here, $K_a$: Coefficient determined by the bearing internal design.

Axial loads and axial displacement for tapered roller bearings are plotted in Fig. 9.23. The amount of axial displacement of tapered roller bearings is proportional to the axial load raised to the 0.9 power. The displacement of ball bearings is proportional to the axial load raised to the 0.67 power, thus the preload required to control displacement is much greater for ball bearings than for tapered roller bearings. Caution should be taken not to make the preload indiscriminately large on tapered roller bearings, since too large of a preload can cause excessive heat, seizure, and reduced bearing life.

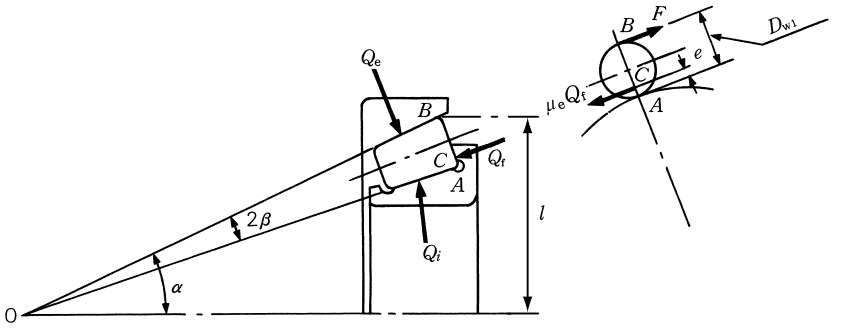



Fig. 9.22

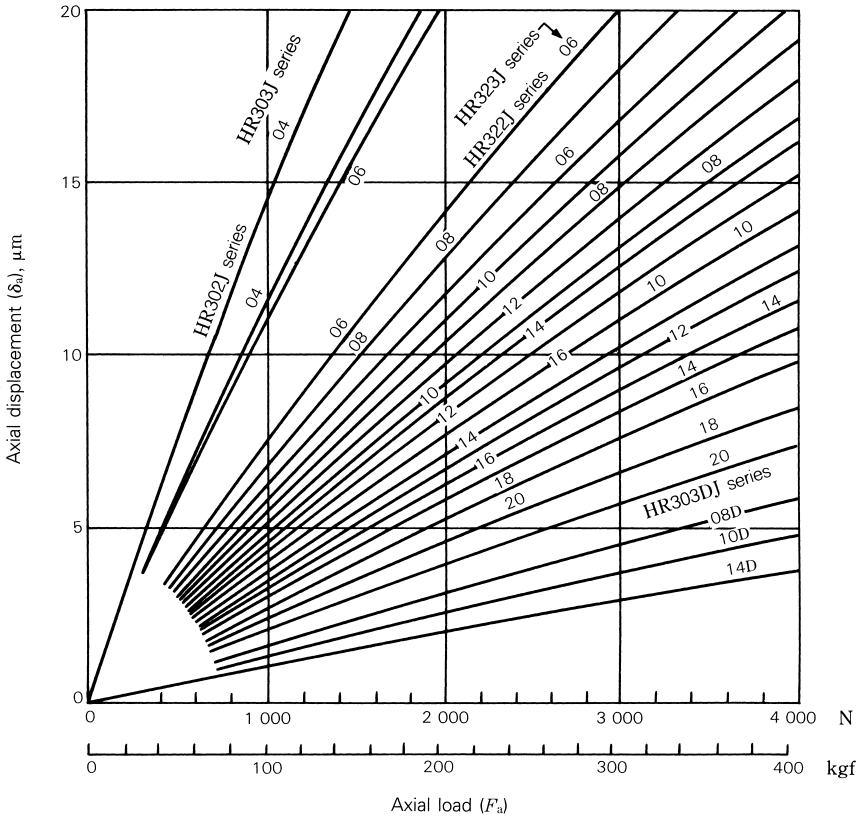
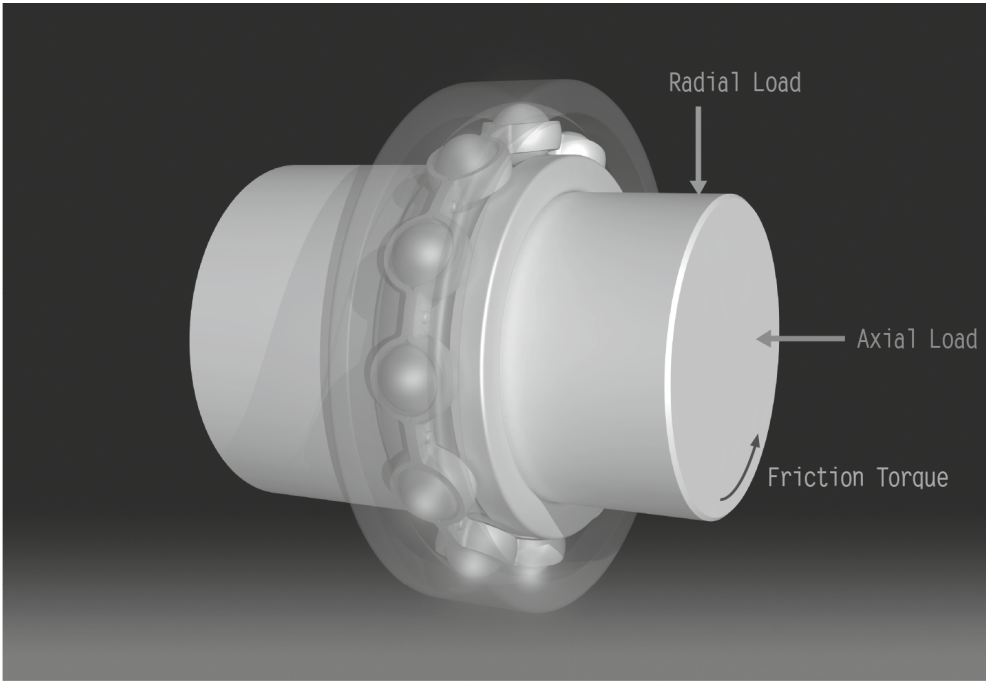



Fig. 9.23 Axial Load and Axial Displacement for Tapered Roller Bearings


Radial Load
Axial Load
Friction Torque

## 10. FRICTION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10.1.1 Bearing Types and Their Coefficients of Dynamic Friction $\mu$ ..... A 216
10.2 Empirical Equations for Running Torque ..... A 216
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10.3.4 Empirical Equations for Running Torque of Tapered Roller Bearings ..... A 222

## 10.1 Coefficients of Dynamic Friction

### 10.1.1 Bearing Types and Their Coefficients of Dynamic Friction $\mu$

$$\mu = \frac{M}{P \cdot \frac{d}{2}} \quad \cdots\cdots (10.1)$$

M : Dynamic friction torque (N·mm), (kgf·mm)
P : Bearing load (Dynamic equivalent load) (N), {kgf}
d : Shaft diameter, Inner ring bore diameter (mm)

**Table 10.1 Coefficients of Dynamic Friction**

| Bearing Types | Approximate values of $\mu$ |
|---|---|
| Deep Groove Ball Bearings | 0.0013 |
| Angular Contact Ball Bearings | 0.0015 |
| Self-Aligning Ball Bearings | 0.0010 |
| Thrust Ball Bearings | 0.0011 |
| Cylindrical Roller Bearings | 0.0010 |
| Tapered Roller Bearings | 0.0022 |
| Spherical Roller Bearings | 0.0028 |
| Needle Roller Bearings with Cages | 0.0015 |
| Full Complement Needle Roller Bearings | 0.0025 |
| Spherical Thrust Roller Bearings | 0.0028 |

## 10.2 Empirical Equations for Running Torque

Dynamic torque of bearing (heat generation) $M = M_l + M_v$

- Load term (Determined by bearing type and load)
  $M_l = f_1 F d_m$
  where $f_1$ : Coefficient determined by bearing type and load
  F : Load
  $d_m$ : Pitch circle diameter of rolling element
- Speed term (Determined by oil viscosity, amount, speed)
  $M_v = f_0 (\nu_0 n)^{2/3} d_m^3$
  where $f_0$ : Coefficient determined by bearing and lubricating method
  $\nu_0$ : Kinematic viscosity of oil
  n : Speed

## 10.3 Technical Data

### 10.3.1 Preload and Starting Torque for Angular Contact Ball Bearings

Angular contact ball bearings, like tapered roller bearings, are most often used in pairs rather than alone or in other multiple bearing sets. Back-to-back and face-to-face bearing sets can be preloaded to adjust bearing rigidity. Extra light (EL), Light (L), Medium (M), and Heavy (H) are standard preloads. Friction torque for the bearing will increase in direct proportion to the preload.
The starting torque of angular contact ball bearings is mainly the torque caused by angular slippage between the balls and contact surfaces on the inner and outer rings. Starting torque for the bearing M due to such spin is given by,

$$M = M_s \cdot Z \sin\alpha \ \text{(N·mm), \{kgf·mm\}} \quad \cdots\cdots (10.2)$$

where, Ms : Spin friction for contact angle a centered on the shaft,

$$M_s = \frac{3}{8} \mu_s \cdot Q \cdot a \cdot E(k)$$

(N·mm), {kgf·mm}

$\mu_s$ : Contact-surface slip friction coefficient
Q : Load on rolling elements (N), {kgf}
a : (1/2) of contact-ellipse major axis (mm)
E (k): With $k = \sqrt{1 - \left(\frac{b}{a}\right)^2}$
as the population parameter, second class complete ellipsoidal integration
b : (1/2) of contact-ellipse minor axis (mm)
Z : Number of balls
$\alpha$ : Contact angle (°)

Actual measurements with 15° angular contact ball bearings correlate well with calculated results using $\mu_s$ = 0.15 in Equation (10.2). Fig. 10.1 shows the calculated friction torque for 70C and 72C series bearings.

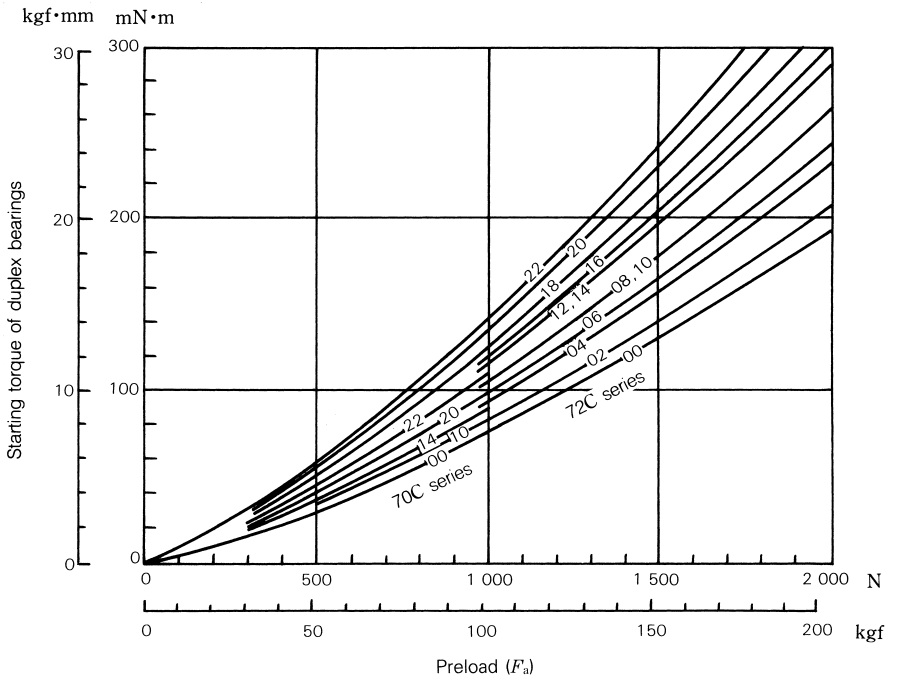


Fig. 10.1 Preload and Starting Torque for Angular Contact Ball Bearings ($\alpha$=15°) of DF and DB Duplex Sets

### 10.3.2 Empirical Equation of Running Torque of High-Speed Ball Bearings

We present here empirical equations for the running torque of high speed ball bearings subject to axial loading and jet lubrication. These equations are based on the results of tests of angular contact ball bearings with bore diameters of 10 to 30 mm, but they can be extrapolated to bigger bearings. The running torque M can be obtained as the sum of a load term $M_l$ and speed term $M_v$ as follows:

$$M=M_l + M_v \text{ (N·mm), \{kgf·mm\}} \quad \cdots\cdots (\mathbf{10.3})$$

The load term Ml is the term for friction, which has no relation with speed or fluid friction, and is expressed by Equation (10.4) which is based on experiments.

$$\left.\begin{aligned} M_l &= 0.672 \times 10^{-3} D_{pw}^{0.7} F_a^{1.2} \text{ (N·mm)} \\ &= 1.06 \times 10^{-3} D_{pw}^{0.7} F_a^{1.2} \text{ \{kgf·mm\}} \end{aligned}\right\} \quad \cdots\cdots (\mathbf{10.4})$$

where, $D_{pw}$: Pitch diameter of rolling elements (mm)
$F_a$: Axial load (N), {kgf}

The speed term Mv is that for fluid friction, which depends on angular speed, and is expressed by Equation (10.5).

$$\begin{aligned} M_v &= 3.47 \times 10^{-10} D_{pw}^{3} n_i^{1.4} Z_B{}^a Q^b \text{ (N·mm)} \\ &= 3.54 \times 10^{-11} D_{pw}^{3} n_i^{1.4} Z_B{}^a Q^b \text{ \{kgf·mm\}} \end{aligned} \quad \cdots\cdots (\mathbf{10.5})$$

where, $n_i$: Inner ring speed ($min^{-1}$)
$Z_B$: Absolute viscosity of oil at outer ring temperature (mPa·s), {cp}
Q: Oil flow rate (kg/min)

The exponents a and b, that affect the oil viscosity and flow rate factors, depend only on the angular speed and are given by Equations (10.6) and (10.7) as follows:

$$a = 24 n_i^{-0.37} \quad \cdots\cdots (\mathbf{10.6})$$

$$b = 4 \times 10^{-9} n_i^{1.6} + 0.03 \quad \cdots\cdots (\mathbf{10.7})$$

An example of the estimation of the running torque of high speed ball bearings is shown in Fig. 10.2. A comparison of values calculated using these equations and actual measurements is shown in Fig. 10.3. When the contact angle exceeds 30°, the influence of spin friction becomes big, so the running torque given by the equations will be low.

#### Calculation Example

Obtain the running torque of high speed angular contact ball bearing 20BNT02 ($\phi 20 \times \phi 47 \times 14$) under the following conditions:

$n_i$=70 000 $min^{-1}$
$F_a$=590 N, {60 kgf}
Lubrication: Jet, oil viscosity:
10 mPa · s {10 cp}
oil flow: 1.5 kg/min

From Equation (10.4),

$$\begin{aligned} M_l &= 0.672 \times 10^{-3} D_{pw}^{0.7} F_a^{1.2} \\ &= 0.672 \times 10^{-3} \times 33.5^{0.7} \times 590^{1.2} \\ &= 16.6 \text{ (N·mm)} \\ M_l &= 1.06 \times 10^{-3} \times 33.5^{0.7} \times 60^{1.2} \\ &= 1.7 \text{ \{kgf·mm\}} \end{aligned}$$

From Equations (10.6) and (10.7),

$$\begin{aligned} a &= 24 n_i^{-0.37} \\ &= 24 \times 70\,000^{-0.37} = 0.39 \\ b &= 4 \times 10^{-9} n_i^{1.6} + 0.03 \\ &= 4 \times 10^{-9} \times 70\,000^{1.6} + 0.03 = 0.26 \end{aligned}$$

From Equation (10.5),

$$\begin{aligned} M_v &= 3.47 \times 10^{-10} D_{pw}^{3} n_i^{1.4} Z_B{}^a Q^b \\ &= 3.47 \times 10^{-10} \times 33.5^3 \times 70\,000^{1.4} \times 10^{0.39} \times 1.5^{0.26} \\ &= 216 \text{ (N·mm)} \end{aligned}$$

$$\begin{aligned} M_v &= 3.54 \times 10^{-11} \times 33.5^3 \times 70\,000^{1.4} \times 10^{0.39} \times 1.5^{0.26} \\ &= 22.0 \text{ \{kgf·mm\}} \end{aligned}$$

$M = M_l + M_v = 16.6 + 216 = 232.6$ (N·mm)
$M = M_l + M_v = 1.7 + 22 = 23.7$ {kgf·mm}

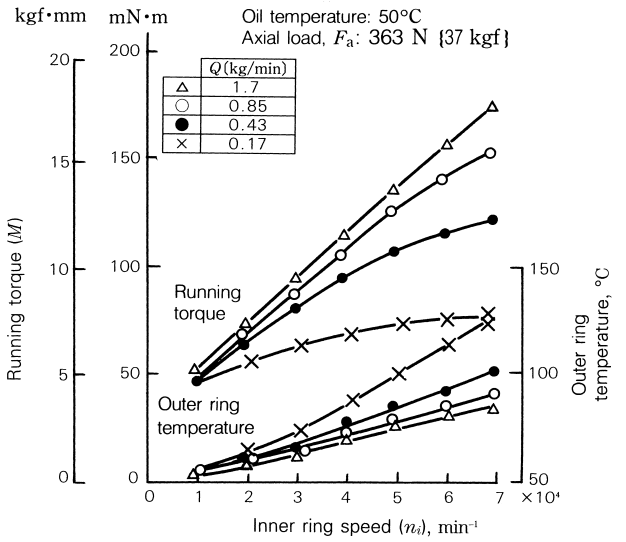


Fig. 10.2 Typical Test Example

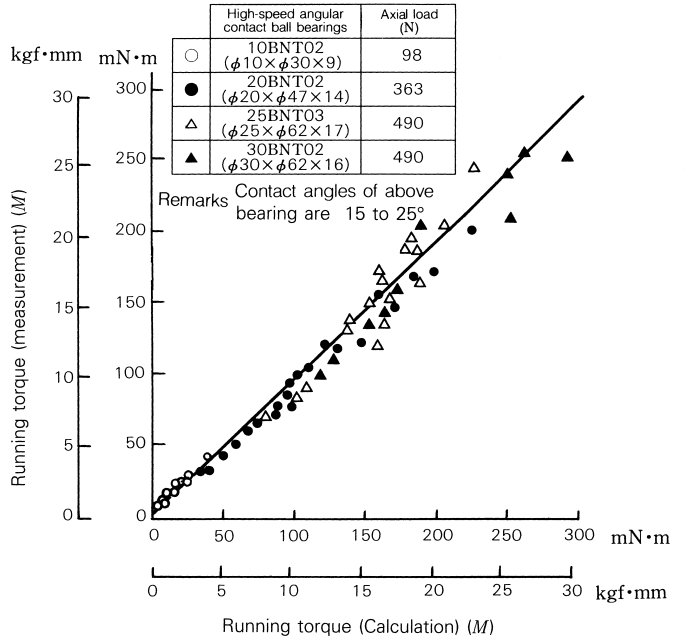


Fig. 10.3 Comparison of Actual Measurements and Calculated Values

### 10.3.3 Preload and Starting Torque for Tapered Roller Bearings

The balance of loads on the bearing rollers when a tapered roller bearing is subjected to axial load $F_a$ is expressed by the following three Equations (10.8), (10.9), and (10.10):

$$Q_e = \frac{F_a}{Z \sin \alpha} \quad \cdots\cdots (\mathbf{10.8})$$

$$Q_i = Q_e \cos 2\beta = \frac{\cos 2\beta}{Z \sin \alpha} F_a \quad \cdots\cdots (\mathbf{10.9})$$

$$Q_f = Q_e \sin 2\beta = \frac{\sin 2\beta}{Z \sin \alpha} F_a \quad \cdots\cdots (\mathbf{10.10})$$

where, $Q_e$ : Rolling element load on outer ring (N), {kgf}
$Q_i$ : Rolling element load on inner ring (N), {kgf}
$Q_f$ : Rolling element load on inner-ring large end rib, (N), {kgf} (assume $Q_f \perp Q_i$)
$Z$ : Number of rollers
$\alpha$ : Contact angle...(1/2) of the cup angle (°)
$\beta$ : (1/2) of tapered roller angle (°)
$D_{w1}$ : Roller large-end diameter (mm) (Fig. 10.4)
e : Contact point between roller end and rib (Fig. 10.4)

As represented in Fig. 10.4, when circumferential load F is applied to the bearing outer ring and the roller turns in the direction of the applied load, the starting torque for contact point C relative to instantaneous center A becomes $e\,\mu_e Q_f$.

Therefore, the balance of frictional torque is,

$$D_{w1}F = e\,\mu_e Q_f \text{ (N·mm), {kgf·mm}} \cdots\cdots (\mathbf{10.11})$$

where, $\mu_e$: Friction coefficient between inner ring large rib and roller endface

The starting torque M for one bearing is given by,

$$M = F\,Z\,l = \frac{e\,\mu_e\, l \sin 2\beta}{D_{w1} \sin \alpha} F_a \text{ (N·mm), {kgf·mm}} \cdots\cdots (\mathbf{10.12})$$

because, $D_{w1} = 2\,\overline{OB} \sin \beta$, and $l = \overline{OB} \sin \alpha$.
If we substitute these into Equation (10.12) we obtain,

$$M = e\,\mu_e \cos\beta\, F_a \text{ (N·mm), {kgf·mm}} \cdots\cdots (\mathbf{10.13})$$

The starting torque M is sought considering only the slip friction between the roller end and the inner-ring large-end rib. However, when the load on a tapered roller bearing reaches or exceeds a certain level (around the preload) the slip friction in the space between the roller end and inner-ring large end rib becomes the decisive factor for bearing starting torque. The torque caused by other factors can be ignored. Values for e and $\beta$ in Equation (10.12) are determined by the bearing design. Consequently, assuming a value for $\mu_e$, the starting torque can be calculated.
The values for $\mu_e$ and for e have to be thought of as a dispersion, thus, even for bearings with the same number, the individual starting torques can be quite diverse. When using a value for e determined by the bearing design, the average value for the bearing starting torque can be estimated using $\mu_e = 0.20$ which is the average value determined from various test results.
Fig. 10.5 shows the results of calculations for various tapered roller bearing series.

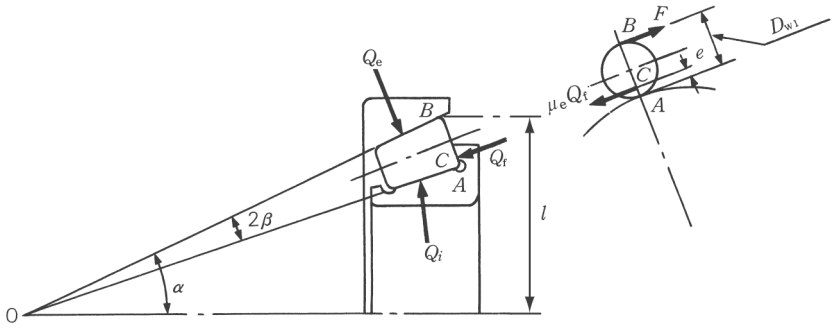


Fig. 10.4

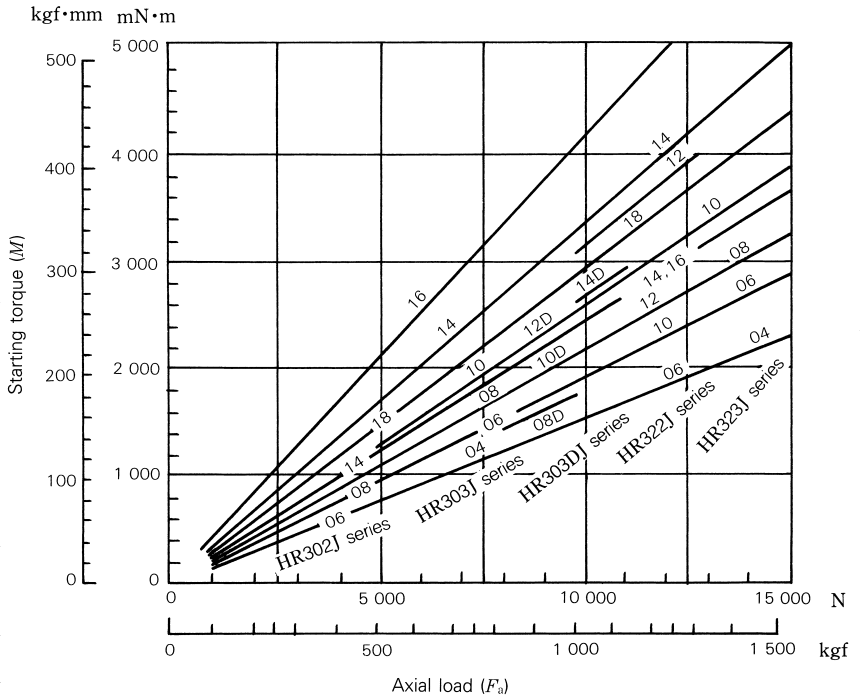


Fig. 10.5 Axial Load and Starting Torque for Tapered Roller Bearings

### 10.3.4 Empirical Equations for Running Torque of Tapered Roller Bearings

When tapered roller bearings operate under axial load, we reanalyzed the torque of tapered roller bearings based on the following two kinds of resistance, which are the major components of friction:

(1) Rolling resistance (friction) of rollers with outer or inner ring raceways — elastic hysteresis and viscous rolling resistance of EHL

(2) Sliding friction between inner ring ribs and roller ends

When an axial load $F_a$ is applied on tapered roller bearings, the loads shown in Fig. 10.6 are applied on the rollers.

$$Q_e \fallingdotseq Q_i = \frac{F_a}{Z \sin \alpha} \quad \cdots\cdots (\mathbf{10.14})$$

$$Q_f = \frac{F_a \sin 2\beta}{Z \sin\alpha} \quad \cdots\cdots (\mathbf{10.15})$$

where, $Q_e$: Rolling element load on outer ring
$Q_i$: Rolling element load on inner ring
$Q_f$: Rolling element load on inner-ring large end rib
$Z$: Number of rollers
$\alpha$: Contact angle…(1/2) of the cup angle
$\beta$: (1/2) of tapered roller angle

For simplification, a model using the average diameter $D_{we}$ as shows in Fig. 10.7 can be used.

where, $M_i$, $M_e$: Rolling resistance (moment)
$F_{si}$, $F_{se}$, $F_{sf}$: Sliding friction
$R_i$, $R_e$: Radii at center of inner and outer ring raceways
e: Contact height of roller end face with rib

In Fig. 10.7, when the balance of sliding friction and moments on the rollers are considered, the following equations are obtained:

$$F_{se} - F_{si} = F_{sf} \quad \cdots\cdots (\mathbf{10.16})$$

$$M_i + M_e = \frac{D_w}{2} F_{se} + \frac{D_w}{2} F_{si} + \left(\frac{D_w}{2} - e\right) F_{sf} \quad \cdots\cdots (\mathbf{10.17})$$

When the running torque M applied on the outer (inner) ring is calculated using Equations (10.16) and (10.17) and multiplying by Z, which is the number of rollers:

$$M = Z (R_e F_{se} - M_e)$$

$$= \frac{Z}{D_w} (R_e M_i + R_i M_e) + \frac{Z}{D_w} R_e e F_{sf}$$

$$= M_R + M_S$$

Therefore, the friction on the raceway surface $M_R$ and that on the ribs $M_S$ are separately obtained. Additionally, $M_R$ and $M_S$ are rolling friction and sliding friction respectively.

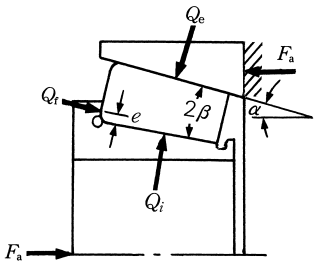


Fig. 10.6 Loads Applied on Roller

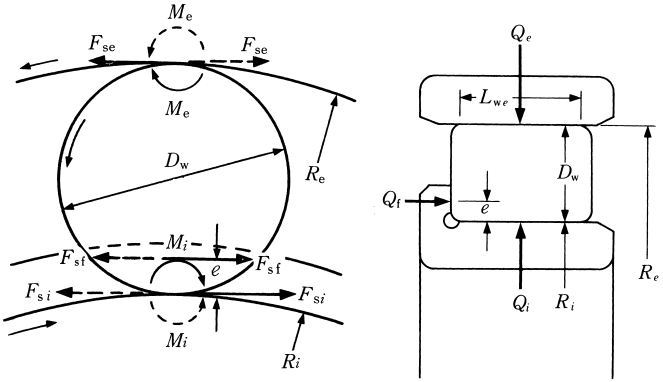


Fig. 10.7 Model of Parts where Friction is Generated

The running torque M of a tapered roller bearing can be obtained from the rolling friction on the raceway $M_R$ and sliding friction on the ribs $M_S$.

$$M = M_R + M_S = \frac{Z}{D_w}(R_e M_i + R_i M_e) + \frac{Z}{D_w} R_e \, e \, F_{sf} \quad \textbf{(10.18)}$$

## Sliding Friction on Rib $M_S$

As a part of $M_S$, $F_{sf}$ is the tangential load caused by sliding, so we can write $F_{sf} = \mu Q_f$ using the coefficient of dynamic friction $\mu$. Further, by substitution of the axial load $F_a$, the following equation is obtained:

$$M_S = e \, \mu \cos\beta \, F_a \quad \textbf{(10.19)}$$

This is the same as the equation for starting torque, but $\mu$ is not constant and it decreases depending on the conditions or running in. For this reason, Equation (10.19) can be rewritten as follows:

$$M_S = e \, \mu_0 \cos\beta \, F_a f' (\Lambda, t, \sigma) \quad \textbf{(10.20)}$$

Where $\mu_0$ is approximately 0.2 and $f'(\Lambda, t, \sigma)$ is a function which decreases with running in and oil film formation, but it is set equal to one when starting.

## Rolling Friction on Raceway Surface $M_R$

Most of the rolling friction on the raceway is viscous oil resistance (EHL rolling resistance). $M_i$ and $M_e$ in Equation (10.18) correspond to it. A theoretical equation exists, but it should be corrected as a result of experiments. We obtained the following equation that includes corrective terms:

$$M_{i,\,e} = \left[ f(w) \left( \frac{1}{1 + 0.29L^{0.78}} \right) \frac{4.318}{\alpha_0} (G \cdot U)^{0.658} W^{0.0126} R^2 L_{we} \right]_{i,\,e} \quad \textbf{(10.21)}$$

$$f(w) = \left( \frac{kF_a}{E' D_w L_{we} Z \sin\alpha} \right)^{0.3} \quad \textbf{(10.22)}$$

Therefore, $M_R$ can be obtained using Equations (10.21) and (10.22) together with the following equation:

$$M_R = \frac{Z}{Dw}(R_e M_i + R_i M_e)$$

## Running Torque of Bearings M

From these, the running torque of tapered roller bearings M is given by Equation (10.23)

$$M = \frac{Z}{Dw}(R_e M_i + R_i M_e) + e \, \mu_0 \cos\beta \, F_a f' (\Lambda, t, \sigma) \quad \textbf{(10.23)}$$

As shown in Figs. 10.8 and 10.9, the values obtained using Equation (10.23) correlate rather well with actual measurements. Therefore, estimation of running torque with good accuracy is possible. When needed, please consult NSK.

## [Explanation of Symbols]

| | |
|---|---|
| G, W, U: | EHL dimensionless parameters |
| L: | Coefficient of thermal load |
| $\alpha_0$: | Pressure coefficient of lubricating oil viscosity |
| R: | Equivalent radius |
| k: | Constant |
| E′: | Equivalent elastic modulus |
| $\alpha$: | Contact angle (Half of cup angle) |
| $R_i$, $R_e$: | Inner and outer ring raceway radii (center) |
| $\beta$: | Half angle of roller |
| i, e: | Indicate inner ring or outer ring respectively |
| $L_{we}$: | Effective roller length |

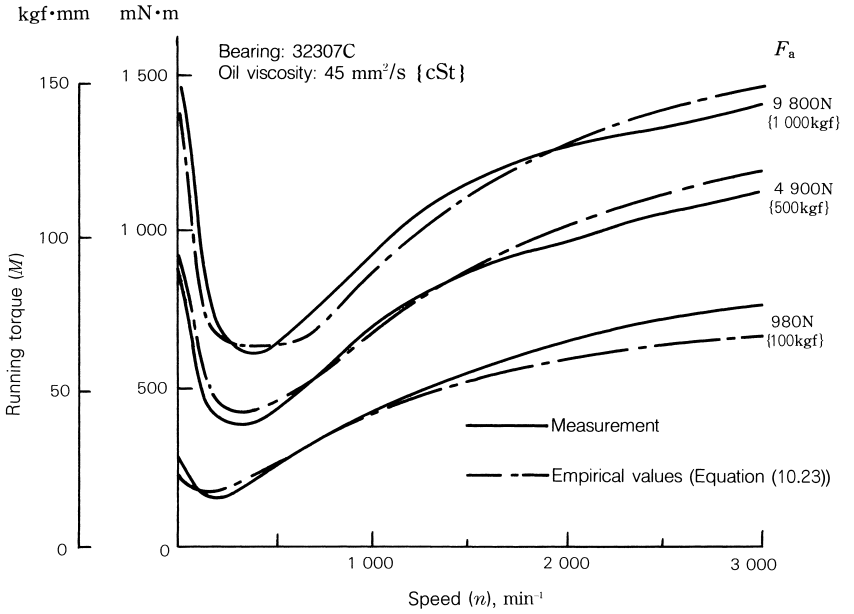


Fig. 10.8 Comparison of Empirical Values with Actual Measurements

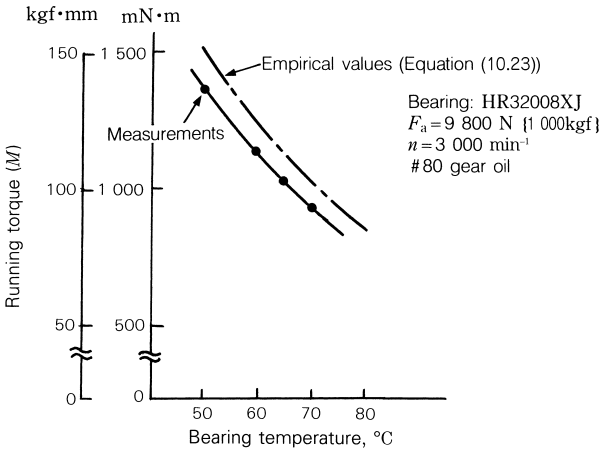


Fig. 10.9 Viscosity Variation and Running Torque


MOTION & CONTROL
NSK
NSK GREASE
LG 2 (Clean Room)
MOTION & CONTROL
NSK
NSK GREASE
LR 3
Net.80g

## 11. LUBRICATION


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## 11.1 Purposes of Lubrication

The main purposes of lubrication are to reduce friction and wear inside the bearings that may cause premature failure. The effects of lubrication may be briefly explained as follows:

### (1) Reduction of Friction and Wear

Direct metallic contact between the bearing rings, rolling elements and cage, which are the basic components of a bearing, is prevented by an oil film which reduces the friction and wear in the contact areas.

### (2) Extension of Fatigue Life

The rolling fatigue life of bearings depends greatly upon the viscosity and film thickness between the rolling contact surfaces. A heavy film thickness prolongs the fatigue life, but it is shortened if the viscosity of the oil is too low so the film thickness is insufficient.

### (3) Dissipation of Frictional Heat and Cooling

Circulation lubrication may be used to carry away frictional heat or heat transferred from the outside to prevent the bearing from overheating and the oil from deteriorating.

### (4) Others

Adequate lubrication also helps to prevent foreign material from entering the bearings and guards against corrosion or rusting.

## 11.2 Lubricating Methods

The various lubricating methods are first divided into either grease or oil lubrication. Satisfactory bearing performance can be achieved by adopting the lubricating method which is most suitable for the particular application and operating condition.

In general, oil offers superior lubrication; however, grease lubrication allows a simpler structure around the bearings. A comparison of grease and oil lubrication is given in Table 11.1.

**Table 11.1 Comparison of Grease and Oil Lubrication**

| Item | Grease Lubrication | Oil Lubrication |
|---|---|---|
| **Housing Structure and Sealing Method** | Simple | May be complex, Careful maintenance required. |
| **Speed** | Limiting speed is 65% to 80% of that with oil lubrication | Higher limiting speed. |
| **Cooling Effect** | Poor | Heat transfer is possible using forced oil circulation. |
| **Fluidity** | Poor | Good |
| **Full Lubricant Replacement** | Sometimes difficult | Easy |
| **Removal of Foreign Matter** | Removal of particles from grease is impossible | Easy |
| **External Contamination due to Leakage** | Surroundings seldom contaminated by leakage | Often leaks without proper countermeasures. Not suitable if external contamination must be avoided. |

### 11.2.1 Grease Lubrication

#### (1) Grease Quantity

The quantity of grease to be packed in a housing depends on the housing design and free space, grease characteristics, and ambient temperature. For example, the bearings for the main shafts of machine tools, where the accuracy may be impaired by a small temperature rise, require only a small amount of grease. The quantity of grease for ordinary bearings is determined as follows.

Sufficient grease must be packed inside the bearing including the cage guide face. The available space inside the housing to be packed with grease depends on the speed as follows:

1/2 to 2/3 of the space ... When the speed is less than 50% of the limiting speed.

1/3 to 1/2 of the space ... When the speed is more than 50% of the limiting speed.

### (2) Replacement of Grease

Grease, once packed, usually does not need to be replenished for a long time; however, for severe operating conditions, grease should be frequently replenished or replaced. In such cases, the bearing housing should be designed to facilitate grease replenishment and replacement. When replenishment intervals are short, provide replenishment and discharge ports at appropriate positions so deteriorated grease is replaced by fresh grease. For example, the housing space on the grease supply side can be divided into several sections with partitions. The grease on the partitioned side gradually passes through the bearings and old grease forced from the bearing is discharged through a grease valve (Fig. 11.1). If a grease valve is not used, the space on the discharge side is made larger than the partitioned side so it can retain the old grease, which is removed periodically by removing the cover.

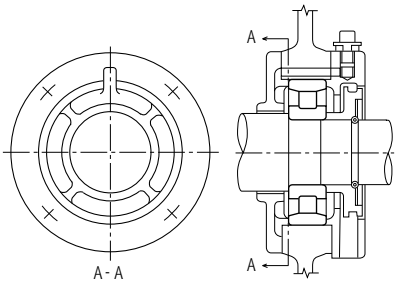



Fig. 11.1 Combination of Partitioned Grease Reservoir and Grease Valve

### (3) Replenishing Interval

Even if high-quality grease is used, there is deterioration of its properties with time; therefore, periodic replenishment is required. Figs. 11.2 (1) and (2) show the replenishment time intervals for various bearing types running at different speeds. Figs. 11.2 (1) and (2) apply for the condition of high-quality lithium soap-mineral oil grease, bearing temperature of 70 °C, and normal load (P/C=0.1).

**› Temperature**

If the bearing temperature exceeds 70 °C, the replenishment time interval must be reduced by half for every 15 °C temperature rise of the bearings.

**› Grease**

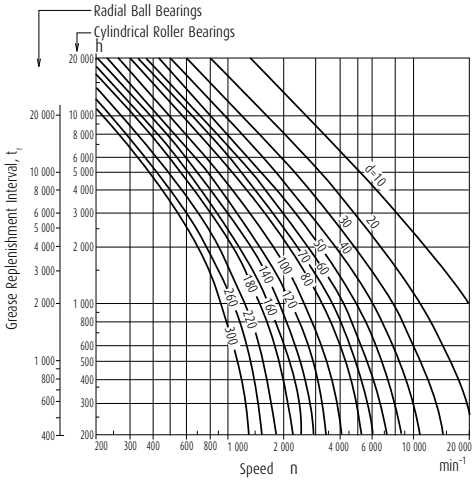
In case of ball bearings especially, the replenishing time interval can be extended depending on used grease type. (For example, high-quality lithium soap-synthetic oil grease may extend about two times of replenishing time interval shown in Fig. 11.2 (1). If the temperature of the bearings is less than 70 °C, the usage of lithium soap-mineral oil grease or lithium soap-synthetic oil grease is appropriate.)
It is advisable to consult NSK.

**› Load**

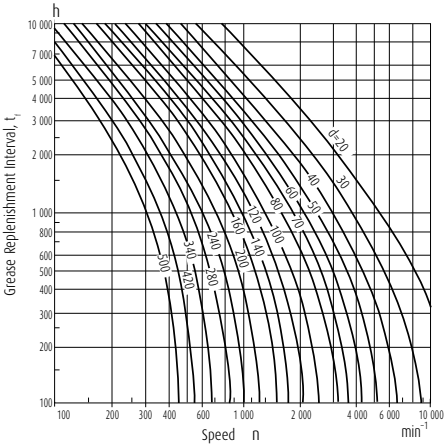
The replenishing time interval depends on the magnitude of the bearing load.

Please refer to Fig. 11.2 (3).

If P/C exceeds 0.16, it is advisable to consult NSK.




(1) Radial Ball Bearings, Cylindrical Roller Bearings




(2) Tapered Roller Bearings, Spherical Roller Bearings

(3) Load factor

| P/C | ≦0.06 | 0.1 | 0.13 | 0.16 |
|---|---|---|---|---|
| Load factor | 1.5 | 1 | 0.65 | 0.45 |

Fig. 11.2 Grease Replenishment Intervals

## (4) Grease Life of Sealed Ball Bearings

When grease is packed into single-row deep groove ball bearings, the grease life may be estimated using Equation (11.1) or (11.2) or Fig. 11.3:

(General purpose grease (1))

$$\log t = 6.54 - 2.6\frac{n}{N_{max}} - \left(0.025 - 0.012\frac{n}{N_{max}}\right)T \quad \cdots\cdots (\mathbf{11.1})$$

(Wide-range grease (2))

$$\log t = 6.12 - 1.4\frac{n}{N_{max}} - \left(0.018 - 0.006\frac{n}{N_{max}}\right)T \quad \cdots\cdots (\mathbf{11.2})$$

where t : Average grease life, (h)

n : Speed ($min^{-1}$)

$N_{max}$ : Limiting speed with grease lubrication ($min^{-1}$) (values for ZZ and VV types listed in the bearing tables)

T : Operating temperature ℃

Equations (11.1) and (11.2) and Fig. 11.3 apply under the following conditions:

(a) Speed, n

$$0.25 \leq \frac{n}{N_{max}} \leq 1$$

when $\frac{n}{N_{max}} < 0.25$, assume $\frac{n}{N_{max}} = 0.25$

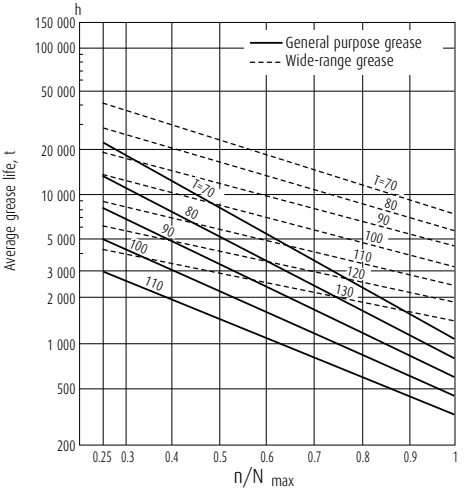



Fig. 11.3 Grease Life of Sealed Ball Bearings

(b) Operating Temperature, T

For general purpose grease (1)

$70\ °C \leq T \leq 110\ °C$

For wide-range grease (2)

$70\ °C \leq T \leq 130\ °C$

When $T < 70\ °C$ assume $T = 70\ °C$

(c) Bearing Loads

The bearing loads should be about 1/10 or less of the basic load rating $C_r$.

**Notes**

(1) Mineral-oil base greases (e.g. lithium soap base grease) which are often used over a temperature range of around −10 to 110 °C.

(2) Synthetic-oil base greases are usable over a wide temperature range of around −40 to 130 °C.

### 11.2.2 Oil Lubrication

#### (1) Oil Bath Lubrication

Oil bath lubrication is a widely used with low or medium speeds. The oil level should be at the center of the lowest rolling element. It is desirable to provide a sight gauge so the proper oil level may be maintained (Fig. 11.4).

#### (2) Drip-Feed Lubrication

Drip feed lubrication is widely used for small ball bearings operated at relatively high speeds. As shown in Fig. 11.5, oil is stored in a visible oiler. The oil drip rate is controlled with the screw in the top.

#### (3) Splash Lubrication

With this lubricating method, oil is splashed onto the bearings by gears or a simple rotating disc installed near the bearings without submerging the bearings in oil.

This method is commonly used in automobile transmissions and final drive gears. Fig. 11.6 shows this lubricating method used on a reduction gear.

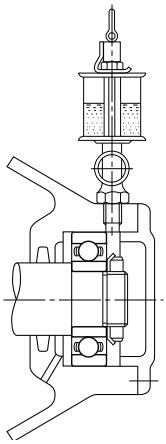


Fig. 11.5 Drip Feed Lubrication

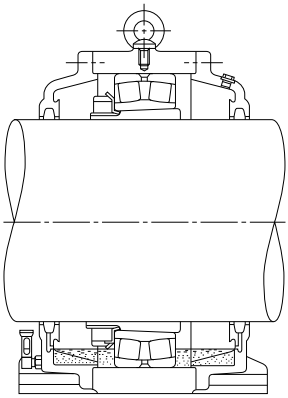


Fig. 11.4 Oil Bath Lubrication

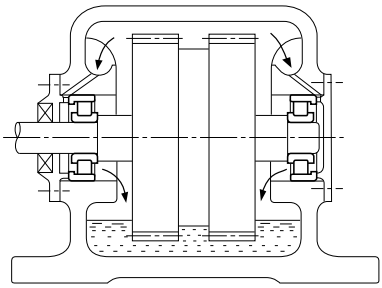
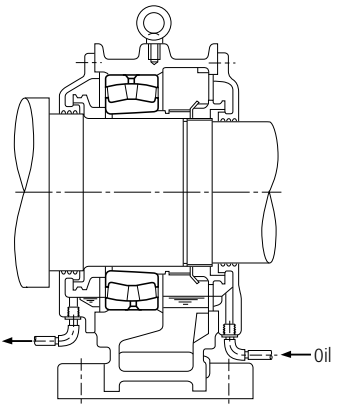


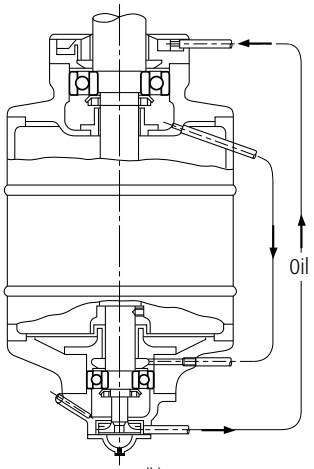
Fig. 11.6 Splash Lubrication

### (4) Circulating Lubrication

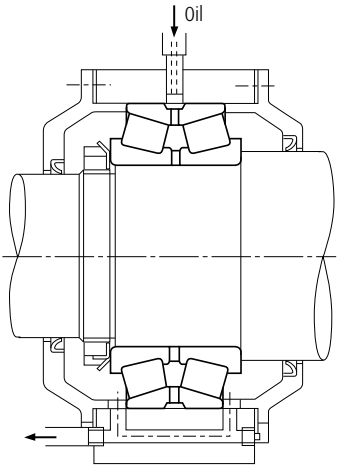
Circulating lubrication is commonly used for high speed operation requiring bearing cooling and for bearings used at high temperatures. As shown in Fig. 11.7 (a), oil is supplied by the pipe on the right side, it travels through the bearing, and drains out through the pipe on the left. After being cooled in a reservoir, it returns to the bearing through a pump and filter.
The oil discharge pipe should be larger than the supply pipe so an excessive amount of oil will not back up in the housing.




(a)




(b)




(c)

Fig. 11.7 Circulating Lubrication

### (5) Jet lubrication

Jet lubrication is often used for ultra high speed bearings, such as the bearings in jet engines with a $d_m n$ valve ($d_m$: pitch diameter of rolling element set in mm; n: rotational speed in $min^{-1}$) exceeding one million. Lubricating oil is sprayed under pressure from one or more nozzles directly into the bearing.

Fig. 11.8 shows an example of ordinary jet lubrication. The lubricating oil is sprayed on the inner ring and cage guide face. In the case of high speed operation, the air surrounding the bearing rotates with it causing the oil jet to be deflected. The jetting speed of the oil from the nozzle should be more than 20% of the circumferential speed of the inner ring outer surface (which is also the guide face for the cage).

More uniform cooling and a better temperature distribution is achieved using more nozzles for a given amount of oil. It is desirable for the oil to be forcibly discharged so the agitating resistance of the lubricant can be reduced and the oil can effectively carry away the heat.

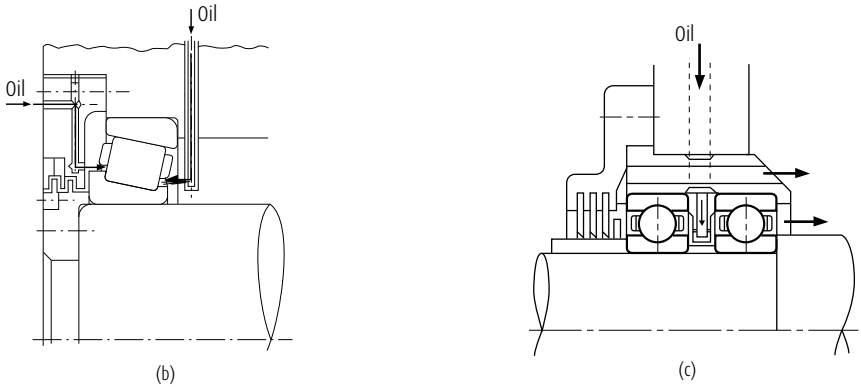



Fig. 11.8 Jet Lubrication

### (6) Oil Mist Lubrication

Oil mist lubrication, also called oil fog lubrication, utilizes an oil mist sprayed into a bearing. This method has the following advantages:

(a) Because of the small quantity of oil required, the oil agitation resistance is small, and higher speeds are possible.

(b) Contamination of the vicinity around the bearing is slight because the oil leakage is small.

(c) It is relatively easy to continuously supply fresh oil; therefore, the bearing life is extended.

This lubricating method is used in bearings for the high speed spindles of machine tools, high speed pumps, roll necks of rolling mills, etc (Fig. 11.9).
For oil mist lubrication of large bearings, it is advisable to consult NSK.

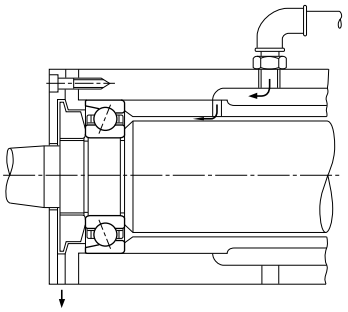


Fig. 11.9 Oil Mist Lubrication

### (7) Oil/Air Lubricating Method

Using the oil/air lubricating method, a very small amount of oil is discharged intermittently by a constant-quantity piston into a pipe carrying a constant flow of compressed air. The oil flows along the wall of the pipe and approaches a constant flow rate.
The major advantages of oil/air lubrication are:

(a) Since the minimum necessary amount of oil is supplied, this method is suitable for high speeds because less heat is generated.

(b) Since the minimum amount of oil is fed continuously, bearing temperature remains stable. Also, because of the small amount of oil, there is almost no atmospheric pollution.

(c) Since only fresh oil is fed to the bearings, oil deterioration need not be considered.

(d) Since compressed air is always fed to the bearings, the internal pressure is high, so dust, cutting fluid, etc. cannot enter.

For these reasons, this method is used in the main spindles of machine tools and other high speed applications (Fig. 11.10).

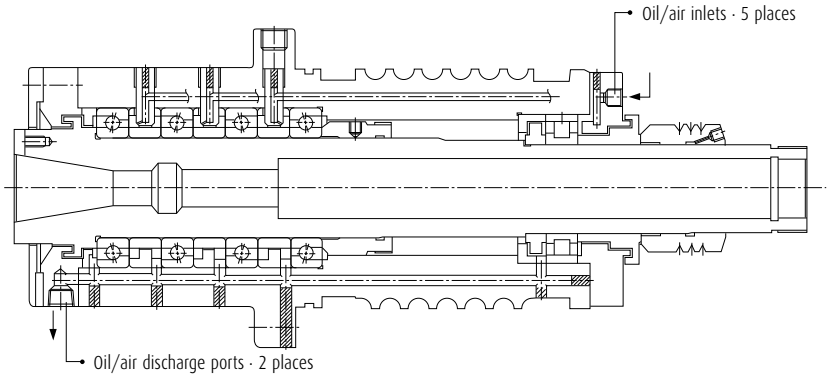



Fig. 11.10 Oil/Air Lubrication

## 11.3 Lubricants

### 11.3.1 Lubricating Grease

Grease is a semi-solid lubricant consisting of base oil, a thickener and additives. The main types and general properties of grease are shown in Table 11.2. It should be remembered that different brands of the same type of grease may have different properties.

#### (1) Base Oil

Mineral oils or synthetic oils such as silicone or diester oil are mainly used as the base oil for grease. The lubricating properties of grease depend mainly on the characteristics of its base oil. Therefore, the viscosity of the base oil is just as important when selecting grease as when selecting an oil. Usually, grease made with low viscosity base oils is more suitable for high speeds and low temperatures, while greases made with high viscosity base oils are more suited for high temperatures and heavy loads.
However, the thickener also influences the lubricating properties of grease; therefore, the selection criteria for grease is not the same as for lubricating oil. Moreover, please be aware that ester-based grease will cause acrylic rubber material to swell, and that silicone-based grease will cause silicone-based material to swell.

#### (2) Thickener

As thickeners for lubricating grease, there are several types of metallic soaps, inorganic thickeners such as silica gel and bentonite, and heat resisting organic thickeners such as polyurea and fluoric compounds.
The type of thickener is closely related to the grease dropping point (1); generally, grease with a high dropping point also has a high temperature capability during operation. However, this type of grease does not have a high working temperature unless the base oil is heat-resistant. The highest possible working temperature for grease should be determined considering the heat resistance of the base oil.
The water resistance of grease depends upon the type of thickener. Sodium soap grease or compound grease containing sodium soap emulsifies when exposed to water or high humidity, and therefore, cannot be used where moisture is prevalent. Moreover, please be aware that urea-based grease will cause fluorine-based material to deteriorate.

Note (1) The grease dropping point is that temperature at which a grease heated in a specified small container becomes sufficiently fluid to drip.

Table 11.2 Grease Properties

| Name (Popular name) | Lithium Grease | | |
|---|---|---|---|
| Thickener | Li Soap | | |
| Base Oil / Properties | Mineral Oil | Diester Oil, Polyatomic Ester Oil | Silicone Oil |
| Dropping Point,°C | 170 to 195 | 170 to 195 | 200 to 210 |
| Working Temperatures, °C | –20 to +110 | –50 to +130 | –50 to +160 |
| Working Speed, %(1) | 70 | 100 | 60 |
| Mechanical Stability | Good | Good | Good |
| Pressure Resistance | Fair | Fair | Poor |
| Water Resistance | Good | Good | Good |
| Rust Prevention | Good | Good | Poor |
| Remarks | General purpose grease used for numerous applications | Good low temperature and torque characteristics. Often used for small motors and instrument bearings. Pay attention to rust caused by insulation varnish. | Mainly for high temperature applications. Unsuitable for bearings for high and low speeds or heavy loads or those having numerous sliding-contact areas (roller bearings, etc.) |

Note (1) The values listed are percentages of the limiting speeds given in the bearing tables.

#### (3) Additives

Grease often contains various additives such as antioxidants, corrosion inhibitors, and extreme pressure additives to give it special properties. It is recommended that extreme pressure additives be used in heavy load applications. For long use without replenishment, an antioxidant should be added.

#### (4) Consistency

Consistency indicates the "softness" of grease. Table 11.3 shows the relation between consistency and working conditions.

| Sodium Grease (Fiber Grease) | Calcium Grease (Cup Grease) | Mixed Base Grease | Complex Base Grease (Complex Grease) | Non-Soap Base Grease (Non-Soap Grease) | |
|---|---|---|---|---|---|
| Na Soap | Ca Soap | Na + Ca Soap, Li + Ca Soap, etc. | Ca Complex Soap, Al Complex Soap, Li Complex Soap, etc. | Urea, Bentonite, Carbon Black, Fluoric Compounds, Heat Resistant Organic Compound, etc. | |
| Mineral Oil | Mineral Oil | Mineral Oil | Mineral Oil | Mineral Oil | Synthetic Oil (Ester Oil, Polyatomic Ester Oil, Synthetic Hydrocarbon Oil, Silicone Oil, Fluoric Based Oil) |
| 170 to 210 | 70 to 90 | 160 to 190 | 180 to 300 | > 230 | > 230 |
| –20 to +130 | –20 to +60 | –20 to +80 | –20 to +130 | –10 to +130 | < +220 |
| 70 | 40 | 70 | 70 | 70 | 40 to 100 |
| Good | Poor | Good | Good | Good | Good |
| Fair | Poor | Fair to Good | Fair to Good | Fair | Fair |
| Poor | Good | Poor for Na Soap Grease | Good | Good | Good |
| Poor to Good | Good | Fair to Good | Fair to Good | Fair to Good | Fair to Good |
| Long and short fiber types are available. Long fiber grease is unsuitable for high speeds. Attention to water and high temperature is requred. | Extreme pressure grease containing high viscosity mineral oil and extreme pressure additive (Pb soap, etc.) has high pressure resistance. | Often used for roller bearings and large ball bearing. | Suitable for extreme pressures mechanically stable | Mineral oil base grease is middle and high temperature purpose lubricant. Synthetic oil base grease is recommended for low or high temperature. Some silicone and fluoric oil based grease have poor rust prevention and noise. | |

Remark The grease properties shown here can vary between brands.

## Table 11.3 Consistency and Working Conditions

| Consistency Number | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Consistency (1) 1/10 mm | 355 to 385 | 310 to 340 | 265 to 295 | 220 to 250 | 175 to 205 |
| Working Conditions (Application) | › For centralized oiling<br>› When fretting is likely to occur | › For centralized oiling<br>› When fretting is likely to occur<br>› For low temperatures | › For general use<br>› For sealed ball bearings | › For general use<br>› For sealed ball bearings<br>› For high temperatures | › For high temperatures<br>› For grease seals |

Note (1) Consistency: The depth to which a cone descends into grease when a specified weight is applied, indicated in units of 1/10 mm. The larger the value, the softer the grease.

### (5) Mixing Different Types of Grease

In general, different brands of grease must not be mixed. Mixing grease with different types of thickneners may destroy its composition and physical properties. Even if the thickeners are of the same type, possible differences in the additive may cause detrimental effects.

## 11.3.2 Lubricating Oil

The lubricating oils used for rolling bearings are usually highly refined mineral oil or synthetic oil that have a high oil film strength and superior oxidation and corrosion resistance. When selecting a lubricating oil, the viscosity at the operating conditions is important. If the viscosity is too low, a proper oil film is not formed and abnormal wear and seizure may occur. On the other hand, if the viscosity is too high, excessive viscous resistance may cause heating or large power loss. In general, low viscosity oils should be used at high speed; however, the viscosity should increase with increasing bearing load and size.

Table 11.4 gives generally recommended viscosities for bearings under normal operating conditions.
For use when selecting the proper lubricating oil, Fig. 11.11 shows the relationship between oil temperature and viscosity, and examples of selection are shown in Table 11.5.

**Table 11.4 Bearing Types and Proper Viscosity of Lubricating Oils**

| Bearing Type | Proper Viscosity at Operating Temperature |
|---|---|
| **Ball Bearings and Cylindrical Roller Bearings** | Higher than 13 $mm^2/s$ |
| **Tapered Roller Bearings and Spherical Roller Bearings** | Higher than 20 $mm^2/s$ |
| **Spherical Thrust Roller Bearings** | Higher than 32 $mm^2/s$ |

**Remark** $1mm^2/s=1cSt$ (centistokes)

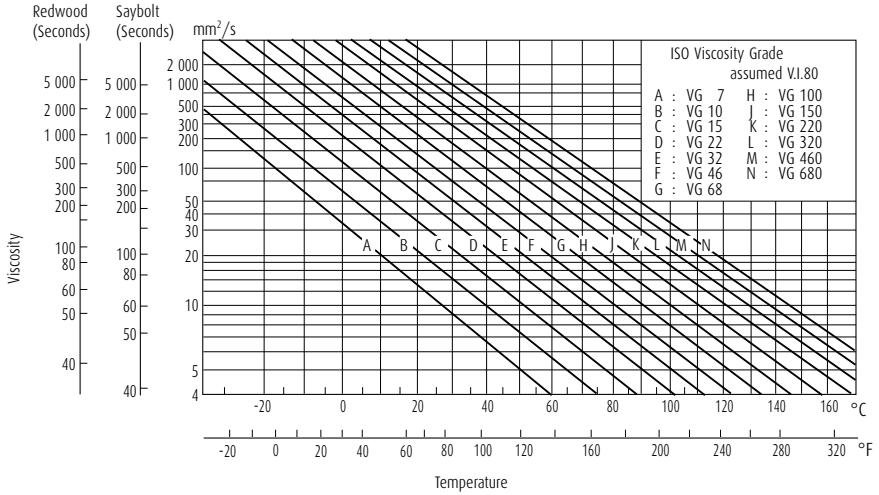



Fig. 11.11 Temperature-Viscosity Chart

## Oil Replacement Intervals

Oil replacement intervals depend on the operating conditions and oil quantity.
In those cases where the operating temperature is less than 50 ˚C, and the environmental conditions are good with little dust, the oil should be replaced approximately once a year. However, in cases where the oil temperature is about 100 ˚C, the oil must be changed at least once every three months.

If moisture may enter or if foreign matter may be mixed in the oil, then the oil replacement interval must be shortened. Mixing different brands of oil must be prevented for the same reason given previously for grease.

### Table 11.5 Examples of Selection Lubricating Oils

| Operating Temperature | Speed | Light or normal Load | Heavy or Shock Load |
|---|---|---|---|
| – 30 to 0 ℃ | Less than limiting speed | ISO VG 15, 22, 32 (refrigerating machine oil) | – |
| 0 to 50 ℃ | Less than 50% of limiting speed | ISO VG 32, 46, 68 (bearing oil, turbine oil) | ISO VG 46, 68, 100 (bearing oil, turbine oil) |
| | 50 to 100% of limiting speed | ISO VG 15, 22, 32 (bearing oil, turbine oil) | ISO VG 22, 32, 46 (bearing oil, turbine oil) |
| | More than limiting speed | ISO VG 10, 15, 22 (bearing oil) | – |
| 50 to 80 ℃ | Less than 50% of limiting speed | ISO VG 100, 150, 220 (bearings oil) | ISO VG 150, 220, 320 (bearing oil) |
| | 50 to 100% of limiting speed | ISO VG 46, 68, 100 (bearing oil, turbine oil) | ISO VG 68, 100, 150 (bearing oil, turbine oil) |
| | More than limiting speed | ISO VG 32, 46, 68 (bearing oil, turbine oil) | – |
| 80 to 110 ℃ | Less than 50% of limiting speed | ISO VG 320, 460 (bearing oil) | ISO VG 460, 680 (bearing oil, gear oil) |
| | 50 to 100% of limiting speed | ISO VG 150, 220 (bearing oil) | ISO VG 220, 320 (bearing oil) |
| | More than limiting speed | ISO VG 68, 100 (bearing oil, turbine oil) | – |

**Remarks**
1. For the limiting speed, use the values listed in the bearing tables.
2. Refer to Refrigerating Machine Oils (JIS K 2211), Bearing Oils (JIS K 2239), Turbine Oils (JIS K 2213), Gear Oils (JIS K 2219).
3. If the operating temperature is near the high end of the temperature range listed in the left column, select a high viscosity oil.
4. If the operating temperature is lower than -30 °C or higher than 110 °C , it is advisable to consult NSK.

## 11.4 Technical Data
### 11.4.1 Brands and Properties of Lubricating Greases

#### Table 11.6 Brands of Lubricating Greases

| Brands | NSK-Code | Thickeners | Base Oils |
|---|---|---|---|
| APOLLOIL AUTOLEX A | ALA | Lithium | Mineral oil |
| APAPEN RB320 | R32 | Lithium/Calcium | Mineral oil |
| EA2 GREASE | EA2 | Urea (3) | Poly-α-olefin oil |
| EA3 GREASE | EA3 | Urea (3) | Poly-α-olefin oil |
| EA5 GREASE | EA5 | Urea (3) | Poly-α-olefin oil |
| EA7 GREASE | EA7 | Urea (3) | Poly-α-olefin oil |
| ENC GREASE | ENC | Urea (3) | Polyol ester oil + Mineral oil (4) |
| ENS GREASE | ENS | Urea (3) | Polyol ester oil (4) |
| ECE GREASE | ECE | Lithium | Poly-α-olefin oil |
| ISOFLEX NBU 15 | NB5 | Barium Complex | Ester oil + Mineral oil |
| ISOFLEX SUPER LDS 18 | D8S | Lithium | Ester oil (4) |
| ISOFLEX TOPAS NB 52 | TN5 | Barium Complex | Poly-α-olefin oil |
| MOLYKOTE SH33L GREASE | D3L | Lithium | Silicone oil (5) |
| MOLYKOTE SH44M GREASE | D4M | Lithium | Silicone oil (5) |
| NS HI-LUBE | NS7 | Lithium | Polyol ester oil + Diester oil (4) |
| NSC GREASE | NSC | Lithium | Alkyldiphenyl ether oil + Polyol ester oil (4) |
| NSK CLEAN GREASE LG2 | LG2 | Lithium | Poly-α-olefin oil + Mineral oil |
| EMALUBE 8030 | E80 | Urea (3) | Mineral oil |
| MA8 GREASE | MA8 | Urea (3) | Alkyldiphenyl ether oil + Poly-α-olefin oil |
| KRYTOX GPL-524 | K24 | PTFE | Perfluoropolyether oil |
| KP1 GREASE | KP1 | PTFE | Perfluoropolyether oil |
| COSMO WIDE GREASE WR No.3N | WR3 | Sodium Terephtalamate | Ester oil + Mineral oil |
| G-40M | G4M | Lithium | Silicone oil (5) |
| SHELL GADUS S2 V220 2 | AP2 | Lithium | Mineral oil |
| SHELL ALVANIA GREASE S2 | AS2 | Lithium | Mineral oil |
| SHELL ALVANIA GREASE S3 | AS3 | Lithium | Mineral oil |
| CASSIDA GREASE RLS 2 | RLS | Aluminum Complex | Poly-α-olefin oil |
| SHELL SUNLIGHT GREASE 2 | SL2 | Lithium | Mineral oil |
| WPH GREASE | WPH | Urea (3) | Poly-α-olefin oil |
| DEMNUM GREASE L-200 | DL2 | PTFE | Perfluoropolyether oil |
| NIGLUB RSH | RSH | Sodium Complex | Polyalkylene Glycol oil |
| PALMAX RBG | PMK | Lithium Complex | Mineral oil |
| BEACON 325J | B3N | Lithium | Diester oil (4) |
| MULTEMP PS No.2 | PS2 | Lithium | Poly-α-olefin oil + Diester oil (4) |
| MOLYKOTE FS-3451 Grease | FS3 | PTFE | Fluorosilicone oil (5) |
| UME GREASE | UME | Urea (3) | Mineral oil |
| RAREMAX AF-1 | RA1 | Urea (3) | Mineral oil |

Notes
(1) If grease will be used close to or outside the upper or lower limit of the temperature range or in a special environment such as vacuum, it is advisable to consult NSK.
(2) For short-term operation or when cooling is used grease may be used at speeds exceeding the above limits provided the supply of grease is appropriate.
(3) Urea-based grease can cause fluorine-based material to deteriorate.
(4) Ester-based grease can cause acrylic rubber material to swell.
(5) Silicone-based grease can cause silicone-based material to swell.

| Dropping Point (˚C) | Consistency | Working Temperature Range(1) (°C) | Pressure Resistance | Usable Limit Compared to Listed Limiting Speed(2) (%) |
|---|---|---|---|---|
| 198 | 280 | −10 to +110 | Fair | 60 |
| 180 | 305 | −10 to + 80 | Fair | 70 |
| ≥260 | 243 | −40 to +150 | Fair | 100 |
| ≥260 | 230 | −40 to +150 | Fair | 100 |
| ≥260 | 251 | −40 to +160 | Good | 60 |
| ≥260 | 243 | −40 to +160 | Fair | 100 |
| ≥260 | 262 | −40 to +160 | Fair | 70 |
| ≥260 | 264 | −40 to +160 | Poor | 100 |
| ≥260 | 235 | −10 to +120 | Poor | 100 |
| ≥260 | 280 | −20 to +120 | Poor | 100 |
| 195 | 280 | −50 to +110 | Poor | 100 |
| ≥260 | 280 | −40 to +130 | Poor | 90 |
| 210 | 310 | −60 to +120 | Poor | 60 |
| 210 | 260 | −30 to +130 | Poor | 60 |
| 192 | 250 | −40 to +130 | Poor | 100 |
| 192 | 235 | −30 to +140 | Fair | 70 |
| 201 | 199 | −20 to +70 | Poor | 100 |
| ≥260 | 280 | 0 to +130 | Good | 60 |
| ≥260 | 273 | −30 to +160 | Fair | 70 |
| ≥260 | 265 | 0 to +200 | Fair | 70 |
| ≥260 | 290 | −30 to +200 | Fair | 60 |
| ≥230 | 227 | −40 to +130 | Poor | 100 |
| 223 | 252 | −30 to +130 | Poor | 60 |
| 187 | 276 | 0 to + 80 | Good | 60 |
| 181 | 275 | −10 to +110 | Fair | 70 |
| 182 | 242 | −10 to +110 | Fair | 70 |
| ≥240 | 280 | 0 to +120 | Fair | 70 |
| 200 | 274 | −10 to +110 | Fair | 70 |
| 259 | 240 | −40 to +150 | Fair | 70 |
| ≥260 | 280 | −30 to +200 | Fair | 60 |
| ≥260 | 270 | −20 to +140 | Fair | 60 |
| 216 | 300 | −10 to +130 | Good | 70 |
| 190 | 278 | −50 to +110 | Poor | 100 |
| 190 | 275 | −50 to +110 | Poor | 100 |
| ≥260 | 285 | 0 to +180 | Fair | 70 |
| ≥260 | 272 | −10 to +130 | Fair | 70 |
| ≥260 | 300 | −10 to +130 | Fair | 70 |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## 12. BEARING MATERIALS


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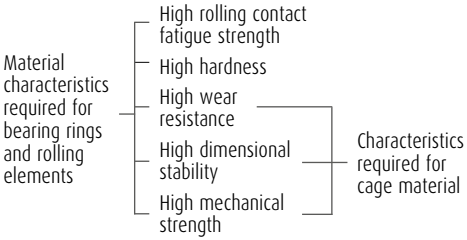
# 12. Bearing Materials

The bearing rings and rolling elements of rolling bearings are subjected to repetitive high pressure with a small amount of sliding. The cages are subjected to tension and compression and sliding contact with the rolling elements and either or both of the bearing rings.

Therefore, the materials used for the rings, rolling elements, and cages require the following characteristics:




Other necessary characteristics, such as easy production, shock and heat resistance, and corrosion resistance, are required depending on individual applications.

## 12.1 Materials for Bearing Rings and Rolling Elements

Primarily, high carbon chromium bearing steel (Table 12.1) is used for the bearing rings and rolling elements. Most NSK bearings are made of SUJ2 among the JIS steel types listed in Table 12.1, while the larger bearings generally use SUJ3. The chemical composition of SUJ2 is approximately the same as AISI 52100 specified in the USA, DIN 100 Cr6 in Germany, and BS 535A99 in UK.

For bearings that are subjected to very severe shock loads, carburized low-carbon alloy steels such as chrome steel, chrome molybdenum steel, nickel chrome molybdenum steel, etc. are often used. Such steels, when they are carburized to the proper depth and have sufficient surface hardness, are more shock resistant than normal, through-hardened bearing steels because of the softer energy-absorbing core. The chemical composition of common carburized bearing steels is listed in Table 12.2.

### Table 12.1 Chemical Composition of High-Carbon Chromium Bearing Steel (Major Elements)

| Standard | Symbols | Chemical Composition (%) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | C | Si | Mn | P | S | Cr | Mo |
| JIS G 4805 | **SUJ 2** | 0.95 to 1.10 | 0.15 to 0.35 | Less than 0.50 | Less than 0.025 | Less than 0.025 | 1.30 to 1.60 | – |
| | **SUJ 3** | 0.95 to 1.10 | 0.40 to 0.70 | 0.90 to 1.15 | Less than 0.025 | Less than 0.025 | 0.90 to 1.20 | – |
| | **SUJ 4** | 0.95 to 1.10 | 0.15 to 0.35 | Less than 0.50 | Less than 0.025 | Less than 0.025 | 1.30 to 1.60 | 0.10 to 0.25 |
| ASTM A 295 | **52100** | 0.93 to 1.05 | 0.15 to 0.35 | 0.25 to 0.45 | Less than 0.025 | Less than 0.015 | 1.35 to 1.60 | Less than 0.10 |

### Table 12.2 Chemical Composition of Carburizing Bearing Steels (Major Elements)

| Standard | Symbols | Chemical Composition (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | C | Si | Mn | P | S | Ni | Cr | Mo |
| JIS G 4052 | **SCr 420 H** | 0.17 to 0.23 | 0.15 to 0.35 | 0.55 to 0.95 | Less than 0.030 | Less than 0.030 | Less than 0.25 | 0.85 to 1.25 | – |
| | **SCM 420 H** | 0.17 to 0.23 | 0.15 to 0.35 | 0.55 to 0.95 | Less than 0.030 | Less than 0.030 | Less than 0.25 | 0.85 to 1.25 | 0.15 to 0.35 |
| | **SNCM 220 H** | 0.17 to 0.23 | 0.15 to 0.35 | 0.60 to 0.95 | Less than 0.030 | Less than 0.030 | 0.35 to 0.75 | 0.35 to 0.65 | 0.15 to 0.30 |
| | **SNCM 420 H** | 0.17 to 0.23 | 0.15 to 0.35 | 0.40 to 0.70 | Less than 0.030 | Less than 0.030 | 1.55 to 2.00 | 0.35 to 0.65 | 0.15 to 0.30 |
| JIS G 4053 | **SNCM 815** | 0.12 to 0.18 | 0.15 to 0.35 | 0.30 to 0.60 | Less than 0.030 | Less than 0.030 | 4.00 to 4.50 | 0.70 to 1.00 | 0.15 to 0.30 |
| ASTM A 534 | **8620 H** | 0.17 to 0.23 | 0.15 to 0.35 | 0.60 to 0.95 | Less than 0.025 | Less than 0.015 | 0.35 to 0.75 | 0.35 to 0.65 | 0.15 to 0.25 |
| | **4320 H** | 0.17 to 0.23 | 0.15 to 0.35 | 0.40 to 0.70 | Less than 0.025 | Less than 0.015 | 1.55 to 2.00 | 0.35 to 0.65 | 0.20 to 0.30 |
| | **9310 H** | 0.07 to 0.13 | 0.15 to 0.35 | 0.40 to 0.70 | Less than 0.025 | Less than 0.015 | 2.95 to 3.55 | 1.00 to 1.40 | 0.08 to 0.15 |

### Table 12.3 Chemical Composition of High Speed Steel for Bearings Used at High Temperatures

| Standard | Symbols | Chemical Composition (%) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | C | Si | Mn | P | S | Cr | Mo | V | Ni | Cu | Co | W |
| AISI | **M50** | 0.77 to 0.85 | Less than 0.25 | Less than 0.35 | Less than 0.015 | Less than 0.015 | 3.75 to 4.25 | 4.00 to 4.50 | 0.90 to 1.10 | Less than 0.10 | Less than 0.10 | Less than 0.25 | Less than 0.25 |

NSK uses highly pure vacuum-degassed bearing steel containing a minimum of oxygen, nitrogen, and hydrogen compound impurities. The rolling fatigue life of bearings has been remarkably improved using this material combined with the appropriate heat treatment.

For special purpose bearings, high temperature bearing steel, which has superior heat resistance, and stainless steel having good corrosion resistance may be used. The chemical composition of these special materials are given in Tables 12.3 and 12.4.

## 12.2 Cage Materials

The low carbon steels shown in Table 12.5 are the main ones for the pressed cages for bearings. Depending on the purpose, brass or stainless steel may be used. For machined cages, high strength brass (Table 12.6) or carbon steel (Table 12.5) is used. Sometimes synthetic resin is also used.

### Table 12.4 Chemical Composition of Stainless Steel for Rolling Bearing (Major Elements)

| Standard | Symbols | Chemical Composition (%) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | C | Si | Mn | P | S | Cr | Mo |
| JIS G 4303 | **SUS 440 C** | 0.95 to 1.20 | Less than 1.00 | Less than 1.00 | Less than 0.040 | Less than 0.030 | 16.00 to 18.00 | Less than 0.75 |
| SAE J 405 | **51440 C** | 0.95 to 1.20 | Less than 1.00 | Less than 1.00 | Less than 0.040 | Less than 0.030 | 16.00 to 18.00 | Less than 0.75 |

### Table 12.5 Chemical Composition of Steel sheet and Carbon Steel for Cages (Major Elements)

| Classification | Standard | Symbols | Chemical Composition (%) | | | | |
|---|---|---|---|---|---|---|---|
| | | | C | Si | Mn | P | S |
| Steel sheet and strip for pressed cages | JIS G 3141 | **SPCC** | Less than 0.12 | – | Less than 0.50 | Less than 0.04 | Less than 0.045 |
| | BAS 361 | **SPB 2** | 0.13 to 0.20 | Less than 0.30 | 0.25 to 0.60 | Less than 0.03 | Less than 0.030 |
| | JIS G 3311 | **S 50 CM** | 0.47 to 0.53 | 0.15 to 0.35 | 0.60 to 0.90 | Less than 0.03 | Less than 0.035 |
| Carbon steel for machined cages | JIS G 4051 | **S 25 C** | 0.22 to 0.28 | 0.15 to 0.35 | 0.30 to 0.60 | Less than 0.03 | Less than 0.035 |

**Remark** BAS is Japanese Bearing Association Standard.

### Table 12.6 Chemical Composition of High Strength Brass for Machined Cages

| Standard | Symbols | Chemical Composition (%) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Cu | Zn | Mn | Fe | Al | Sn | Ni | Impurities | |
| | | | | | | | | | Pb | Si |
| JIS H 5120 | **CAC301 (HBsC 1)** | 55.0 to 60.0 | 33.0 to 42.0 | 0.1 to 1.5 | 0.5 to 1.5 | 0.5 to 1.5 | Less than 1.0 | Less than 1.0 | Less than 0.4 | Less than 0.1 |
| JIS H 3250 | **C 6782** | 56.0 to 60.5 | Residual | 0.5 to 2.5 | 0.1 to 1.0 | 0.2 to 2.0 | – | – | Less than 0.5 | – |

**Remark** Improved HBsC 1 is also used.

## 12.3 Characteristics of Bearing and Shaft/ Housing Materials

Rolling bearings must be able to resist high load, run at high speed, and endure long-time operation. It is also important to know the characteristics of the shaft and housing materials if the bearing performance is to be fully exploited. Physical and mechanical properties or typical materials of a bearing and shaft/housing are shown for reference in Table 12.7.

| | Material | Heat treatment |
|---|---|---|
| Bearing | SUJ2 | Quenching, tempering |
| | SUJ2 | Spheroidizing annealing |
| | SCr420 | Quenching, low temp tempering |
| | SAE4320 (SNCM420) | Quenching, low temp tempering |
| | SNCM815 | Quenching, low temp tempering |
| | SUS440C | Quenching, low temp tempering |
| | SPCC | Annealing |
| | S25C | Annealing |
| | CAC301 (HBsC1) | — |
| Shaft | S45C | Quenching, 650°C tempering |
| | SCr430 | Quenching, 520 to 620°C fast cooling |
| | SCr440 | Quenching, 520 to 620°C fast cooling |
| | SCM420 | Quenching, 150 to 200°C air cooling |
| | SNCM439 | Quenching, 650°C tempering |
| | SC46 | Normalizing |
| | SUS420J2 | 1 038°C oil cooling, 400°C air cooling |
| Housing | FC200 | Casting |
| | FCD400 | Casting |
| | A1100 | Annealing |
| | AC4C | Casting |
| | ADC10 | Casting |
| | SUS304 | Annealing |

**Note** * JIS standard or reference value.
** Though Rockwell C scale is generally

**Remark** Proportional limits of SUJ2 and SCr420

## Table 12.7 Physical and Mechanical Properties of Bearing and Shaft/Housing Materials

| Density g/cm³ | Specific heat kJ/(kg·K) | Thermal conductivity W/(m·K) | Electric resistance μ Ω·cm | Linear expansion coeff. (0 to 100°C) ×10⁻⁶/°C | Young's modulus MPa {kgf/mm²} | Yield point MPa {kgf/mm²} | Tensile strength MPa {kgf/mm²} | Elongation % | Hardness HB | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 7.83 | 0.47 | 46 | 22 | 12.5 | 208 000 {21 200} | 1 370 {140} | 1 570 to 1 960 {160 to 200} | 0.5 Max. | 650 to 740 | High carbon chrome bearing steel No. 2 |
| 7.86 | | | | 11.9 | | 420 {43} | 647 {66} | 27 | 180 | |
| 7.83 | | 48 | 21 | 12.8 | | 882 {90} | 1 225 {125} | 15 | 370 | Chrome steel |
| | | 44 | 20 | 11.7 | | 902 {92} | 1 009 {103} | 16 | **293 to 375 | Nickel chrome molybdenum steel |
| 7.89 | | 40 | 35 | — | | — | *1 080 {110} Min. | *12 Min. | *311 to 375 | |
| 7.68 | 0.46 | 24 | 60 | 10.1 | 200 000 {20 400} | 1 860 {190} | 1 960 {200} | — | **580 | Martensitic stainless steel |
| 7.86 | 0.47 | 59 | 15 | 11.6 | 206 000 {21 000} | — | *275 {28} Min. | *32 Min. | — | Cold rolled steel plate |
| | 0.48 | 50 | 17 | 11.8 | | 323 {33} | 431 {44} | 33 | 120 | Carbon steel for machine structure |
| 8.5 | 0.38 | 123 | 6.2 | 19.1 | 103 000 {10 500} | — | *431 {44} Min. | *20 Min. | — | High-tension brass |
| 7.83 | 0.48 | 47 | 18 | 12.8 | 207 000 {21 100} | 440 {45} | 735 {75} | 25 | 217 | Carbon steel for machine structure |
| | | | 22 | 12.5 | 208 000 {21 100} | *637 {65} Min. | *784 {80} Min. | *18 Min. | *229 to 293 | Chrome steel |
| | | 45 | 23 | | | *784 {80} Min. | *930 {95} Min. | *13 Min. | *269 to 331 | |
| | 0.47 | 48 | 21 | 12.8 | | — | *930 {95} Min. | *14 Min. | *262 to 352 | Chrome molybdenum steel |
| | | 38 | 30 | 11.3 | 207 000 {21 100} | 920 {94} | 1 030 {105} | 18 | 320 | Nickel chrome molybdenum steel |
| — | — | — | — | — | 206 000 {21 100} | 294 {30} | 520 {53} | 27 | 143 | Low carbon cast steel |
| 7.75 | 0.46 | 22 | 55 | 10.4 | 200 000 {20 400} | 1 440 {147} | 1 650 {168} | 10 | 400 | Martensitic stainless steel |
| 7.3 | 0.50 | 43 | — | | 98 000 {10 000} | — | *200 {20} Min. | — | *217 Max. | Gray cast iron |
| 7.0 | 0.48 | 20 | — | 11.7 | 169 000 {17 200} | *250 {26} Min. | *400 {41} Min. | *12 Min. | *201 Max. | Spheroidal graphite cast iron |
| 2.69 | 0.90 | 222 | 3.0 | 23.7 | 70 600 {7 200} | 34 {3.5} | 78 {8} | 35 | — | Pure aluminum |
| 2.68 | 0.88 | 151 | 4.2 | 21.5 | 72 000 {7 350} | 88 {9} | 167 {17} | 7 | — | Aluminum alloy for sand casting |
| 2.74 | 0.96 | 96 | 7.5 | 22.0 | 71 000 {7 240} | 167 {17} | 323 {33} | 4 | — | Aluminum alloy for die casting |
| 8.03 | 0.50 | 15 | 72 | 15.7 to 16.8 | 193 000 {19 700} | 245 {25} | 588 {60} | 60 | 150 | Austenitic stainless steel |

used, Brinel hardness is shown for comparison.
are 833 MPa {85 kgf/mm²} and 440 MPa {45 kgf/mm²} respectively as reference.

## 12.4 Technical Data

### 12.4.1 Comparison of National Standards of Rolling Bearing Steel

The dimension series of rolling bearings as mechanical elements have been standardized internationally, and the material to be used for them specified in ISO 683/17 (heat treatment, alloy, and free cutting steels / Part 17 ball and roller bearing steels). However, materials are also standardized according to standards of individual countries and, in some cases, makers are even making their own modifications. As internationalization of products incorporating bearings and references to the standards of these kinds of steels are increasing nowadays, applicable standards are compared and their features described for some representative bearing steels.

| JIS G 4805 | ASTM | Other major national standards |
|---|---|---|
| SUJ2 | — | — |
| — | A 295-89 52100 | — |
| — | — | 100Cr6 (DIN) |
| — | — | 100C6 (NF) |
| — | — | 535A99 (BS) |
| SUJ3 | — | — |
| — | A 485-03 Grade 1 | — |
| — | A 485-03 Grade 2 | — |
| SUJ4 | — | — |
| SUJ5 | — | — |
| — | A 485-03 Grade 3 | — |

**Note** *1: P ≦ 0.025, S ≦ 0.025
**Remark** ASTM: Standard of American Society

| JIS G 4052 G 4053 | ASTM A 534-90 | C |
|---|---|---|
| SCr420H | — | 0.17 to 0.23 |
| — | 5120H | 0.17 to 0.23 |
| SCM420H | — | 0.17 to 0.23 |
| — | 4118H | 0.17 to 0.23 |
| SNCM220H | — | 0.17 to 0.23 |
| — | 8620H | 0.17 to 0.23 |
| SNCM420H | — | 0.17 to 0.23 |
| — | 4320H | 0.17 to 0.23 |
| SNCM815 | — | 0.12 to 0.18 |
| — | 9310H | 0.07 to 0.13 |

**Note** *2: P ≦ 0.030, S ≦ 0.030
*3: P ≦ 0.025, S ≦ 0.015

## Table 12.8 Applicable National Standards and Chemical Composition of High-Carbon Chrome Bearing Steel

| | Chemical composition (%) | | | | | | Application | Remarks |
|---|---|---|---|---|---|---|---|---|
| | C | Si | Mn | Cr | Mo | Others | | |
| | 0.95 to 1.10 | 0.15 to 0.35 | ≦0.50 | 1.30 to 1.60 | — | *1 | Typical steel type for small and medium size bearings | Equivalent to each other though there are slight differences in the ranges. |
| | 0.93 to 1.05 | 0.15 to 0.35 | 0.25 to 0.45 | 1.35 to 1.60 | ≦0.08 | P≦0.025<br>S≦0.015 | | |
| | 0.90 to 1.05 | 0.15 to 0.35 | 0.25 to 0.40 | 1.40 to 1.65 | — | — | | |
| | 0.95 to 1.10 | 0.15 to 0.35 | 0.20 to 0.40 | 1.35 to 1.60 | ≦0.08 | P≦0.030<br>S≦0.025 | | |
| | 0.95 to 1.10 | 0.10 to 0.35 | 0.40 to 0.70 | 1.20 to 1.60 | — | *1 | | |
| | 0.95 to 1.10 | 0.40 to 0.70 | 0.90 to 1.15 | 0.90 to 1.20 | — | *1 | For large size bearings | SUJ3 is equivalent to Grade 1. Grade 2 has better quenching capability |
| | 0.90 to 1.05 | 0.45 to 0.75 | 0.90 to 1.20 | 0.90 to 1.20 | ≦0.08 | P≦0.025<br>S≦0.015 | | |
| | 0.85 to 1.00 | 0.50 to 0.80 | 1.40 to 1.70 | 1.40 to 1.80 | ≦0.10 | P≦0.025<br>S≦0.015 | | |
| | 0.95 to 1.10 | 0.15 to 0.35 | ≦0.50 | 1.30 to 1.60 | 0.10 to 0.25 | *1 | Scarcely used | Better quenching capability than SUJ2 |
| | 0.95 to 1.10 | 0.40 to 0.70 | 0.90 to 1.15 | 0.90 to 1.20 | 0.10 to 0.25 | *1 | For ultralarge size bearings | Though Grade 3 is equivalent to SUJ5, quenching capability of Grade 3 is better than SUJ5. |
| | 0.95 to 1.10 | 0.15 to 0.35 | 0.65 to 0.90 | 1.10 to 1.50 | 0.20 to 0.30 | P≦0.025<br>S≦0.015 | | |

of Testing Materials, DIN: German Standard, NF: French Standard, BS: British Standard

## Table 12.9 JIS and ASTM Standards and Chemical Composition of Carburizing Bearing Steel

| | Chemical composition (%) | | | | | | Application | Remarks |
|---|---|---|---|---|---|---|---|---|
| | Si | Mn | Ni | Cr | Mo | Others | | |
| | 0.15 to 0.35 | 0.55 to 0.95 | ≦0.25 | 0.85 to 1.25 | — | *2 | For small bearings | Similar steel type |
| | 0.15 to 0.35 | 0.60 to 1.00 | — | 0.60 to 1.00 | — | *3 | | |
| | 0.15 to 0.35 | 0.55 to 0.95 | ≦0.25 | 0.85 to 1.25 | 0.15 to 0.35 | *2 | For small bearings | Similar steel type, though quenching capability of 4118H is inferior to SCM420H |
| | 0.15 to 0.35 | 0.60 to 1.00 | — | 0.30 to 0.70 | 0.08 to 0.15 | *3 | | |
| | 0.15 to 0.35 | 0.60 to 0.95 | 0.35 to 0.75 | 0.35 to 0.65 | 0.15 to 0.30 | *2 | For small bearings | Equivalent, though there are slight differences |
| | 0.15 to 0.35 | 0.60 to 0.95 | 0.35 to 0.75 | 0.35 to 0.65 | 0.15 to 0.25 | *3 | | |
| | 0.15 to 0.35 | 0.40 to 0.70 | 1.55 to 2.00 | 0.35 to 0.65 | 0.15 to 0.30 | *2 | For medium bearings | Equivalent, though there are slight differences |
| | 0.15 to 0.35 | 0.40 to 0.70 | 1.55 to 2.00 | 0.35 to 0.65 | 0.20 to 0.30 | *3 | | |
| | 0.15 to 0.35 | 0.30 to 0.60 | 4.00 to 4.50 | 0.70 to 1.00 | 0.15 to 0.30 | *2 | For large bearings | Similar steel type |
| | 0.15 to 0.35 | 0.40 to 0.70 | 2.95 to 3.55 | 1.00 to 1.45 | 0.08 to 0.15 | *3 | | |

### 12.4.2 Long Life Bearing Steel (NSK Z Steel)

It is well known that the rolling fatigue life of highcarbon chrome bearing steel (SUJ2, SAE52100) used for rolling bearings is greatly affected by non-metallic inclusions. Non-metallic inclusions are roughly divided into threetypes: sulfide, oxide, and nitride. The life test executed for long periods showed that oxide non-metallic inclusions exert a particularly adverse effect on the rolling fatigue life. Fig. 12.1 shows the parameter (oxygen content) indicating the amount of oxide non-metallic inclusions vs. life. The oxygen amount in steel was minimized as much as possible by reducing impurities (Ti, S) substantially, thereby achieving a decrease in the oxide non-metallic inclusions. The resulting long-life steel is the Z steel. The Z steel is an achievement of improved steelmaking facility and operating conditions made possible by cooperation with a steel maker on the basis of numerous life test data. A graph of the oxygen content in steel over the last 25 years is shown in Fig. 12.2.

The result of the life test with sample material in Fig. 12.2 is shown in Fig. 12.3. The life tends to become longer with decreasing oxygen content in steel. The high-quality Z steel has a life span which is about 1.8 times longer than that of conventional degassed steel.

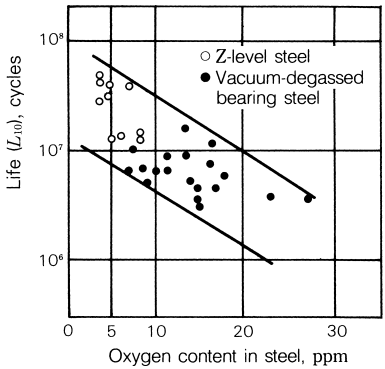



Fig. 12.1 Oxygen Content in Steel and Life of Bearing Steel

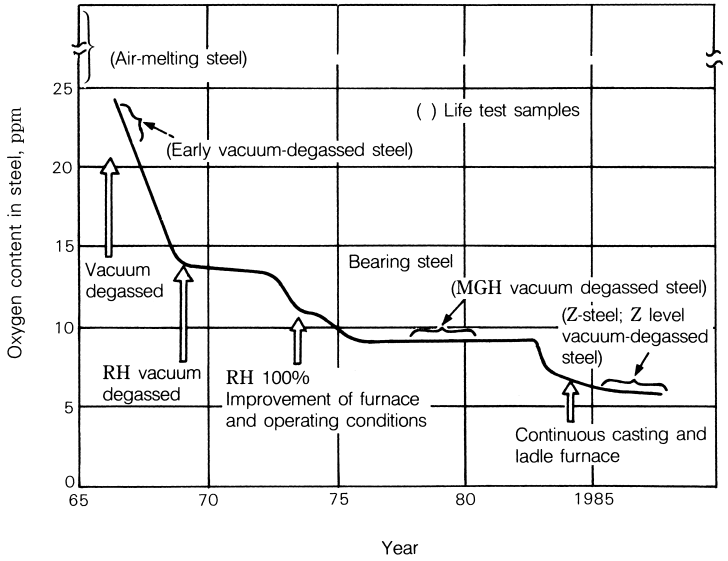
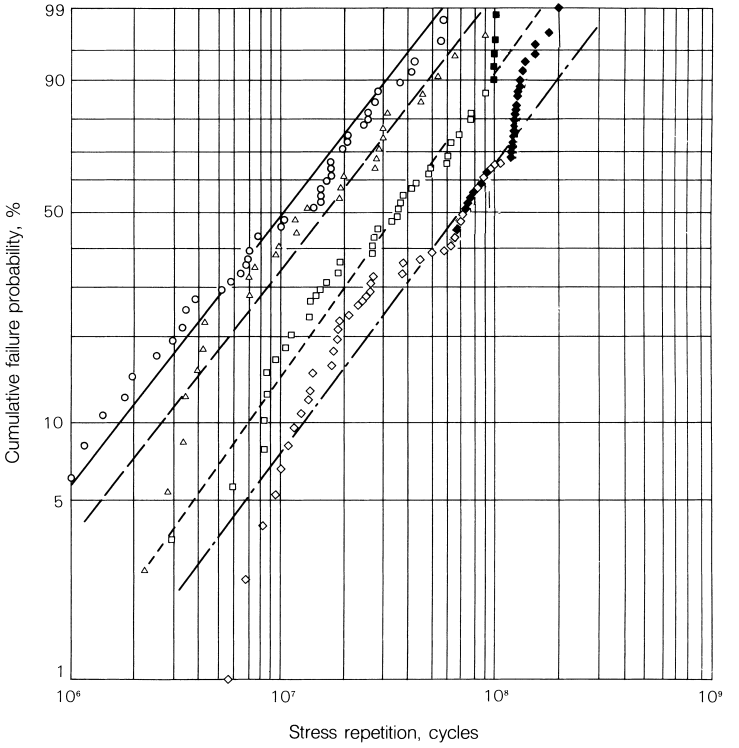



Fig. 12.2 Transition of Oxygen Content in NSK Bearing Steels




| Classification | Test quantity | Failured quantity | Weibull slope | $L_{10}$ | $L_{50}$ |
|---|---|---|---|---|---|
| ○ Air-melting steel | 44 | 44 | 1.02 | $1.67 \times 10^6$ | $1.06 \times 10^7$ |
| △ Vacuum degassed steel | 30 | 30 | 1.10 | $2.82 \times 10^6$ | $1.55 \times 10^7$ |
| □ MGH vacuum degassed steel | 46 | 41 | 1.16 | $6.92 \times 10^6$ | $3.47 \times 10^7$ |
| ◇ Z steel | 70 | 39 | 1.11 | $1.26 \times 10^7$ | $6.89 \times 10^7$ |

**Remark** Testing of bearings marked dark ■ and ◆ has not been finished testing yet.

Fig. 12.3 Result of Thrust Life Test of Bearing Steel

### 12.4.3 Dimensional Stability of Bearing Steel

Sectional changes or changes in the dimensions of rolling bearings as time passes during operation is called aging deformation. When the inner ring develops expansion due to such deformation, the result is a decrease in the interference between the shaft and inner ring. This becomes one of the causes of inner ring creep. Creep phenomenon, by which the shaft and inner ring slip mutually, causes the bearing to proceed from heat generation to seizure, resulting in critical damage to the entire machine. Consequently, appropriate measures must be taken against aging deformation of the bearing depending on the application.

Aging deformation of bearings may be attributed to secular thermal decomposition of retained austenite in steel after heat treatment. The bearing develops gradual expansion along with phase transformation.

The dimensional stability of the bearings, therefore, varies in accordance with the relative relationship between the tempering during heat treatment and the bearing's operating temperature. The bearing dimensional stability increases with rising tempering temperature while the retained austenite decomposition gradually expands as the bearing's operating temperature rises.

Fig. 12.4 shows how temperature influences the bearing's dimensional stability. In the right-hand portion of the figure, the interference between the inner ring and shaft in various shaft tolerance classes is shown as percentages for the shaft diameter. As is evident from Fig. 12.4, the bearing dimensional stability becomes more unfavorable as the bearing's temperature rises. Under these conditions, the interference between the shaft and inner ring of a general bearing is expected to decrease gradually. In this view, loosening of the fit surface needs to be prevented by using a bearing which has received dimension stabilization treatment.

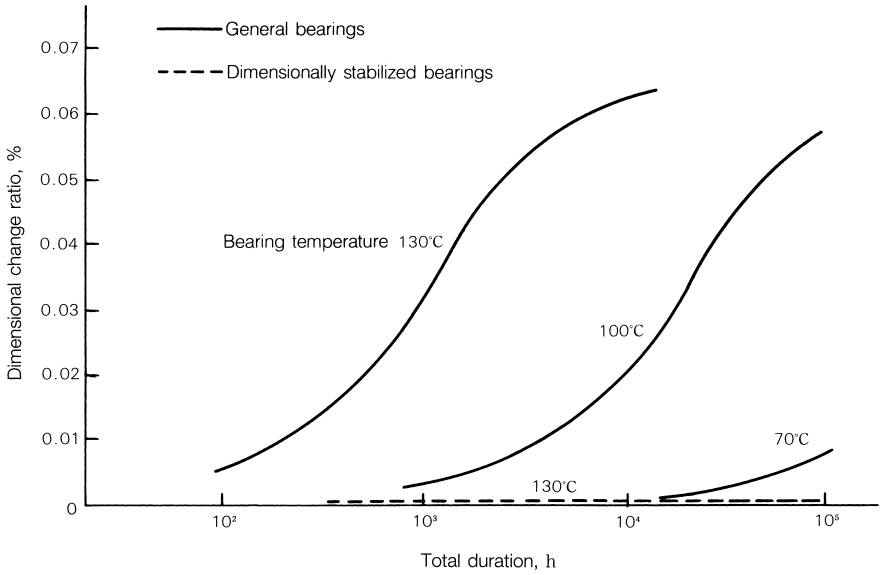
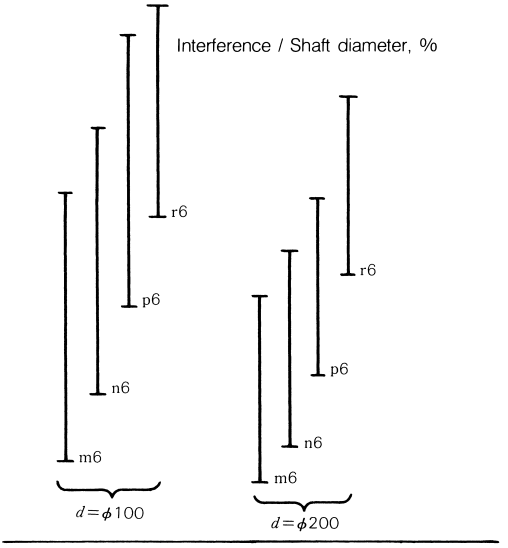



Fig. 12.4 Bearing Temperature and Dimensional Change Ratio

When the bearing temperature is high, there is a possibility of inner ring creep. Since due attention is necessary for selection of an appropriate bearing, it is essential to consult NSK beforehand.



### 12.4.4 Fatigue Analysis

It is necessary for prediction of the fatigue life of rolling bearings and estimation of the residual life to know all fatigue break-down phenomena of bearings. But, it will take some time before we reach a stage enabling prediction and estimation. Rolling fatigue, however, is fatigue proceeding under compressive stress at the contact point and known to develop extremely great material change until breakdown occurs. In many cases, it is possible to estimate the degree of fatigue of bearings by detecting material change. However, this estimation method is not effective in the cases where the defects in the raceway surface cause premature cracking or chemical corrosion occurs on the raceway. In these two cases, flaking grows in advance of the material change.

#### (1) Measurement of Fatigue Degree

The progress of fatigue in a bearing can be determined by using an X-ray to measure changes in the residual stress, diffraction half-value width, and retained austenite amount. These values change as the fatigue progresses as shown in Fig. 12.5. Residual stress, which grows early and approaches the saturation value, can be used to detect extremely small fatigue. For large fatigue, change of the diffraction half-value width and retained austenite amount may be correlated to the progress of fatigue. These measurements with X-ray are put together into one parameter (fatigue index) to determine the relationship with the endurance test period of a bearing. Measured values were collected by carrying out endurance test with many ball, tapered roller, and cylindrical roller bearings under various load and lubrication conditions. Simultaneously, measurements were made on bearings used in actual machines.

Fig. 12.6 summarizes the data. Variance is considerable because data reflects the complexity of the fatigue phenomenon. But, there exists correlation between the fatigue index and the endurance test period or operating hours. If some uncertainty is allowed, the fatigue degree can be handled quantitatively.

Description of “sub-surface fatigue” in Fig. 12.6 applies to the case when fatigue is governed by internal shearing stress. “Surface fatigue” shows correlation when the surface fatigue occurs earlier and more severely than sub-surface fatigue due to contamination or oil film breakdown of lubricating oil.

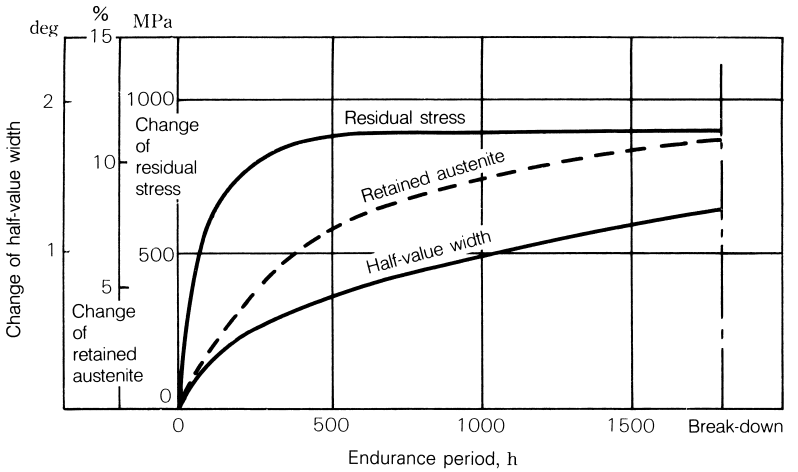



Fig. 12.5 Change in X-ray Measurements

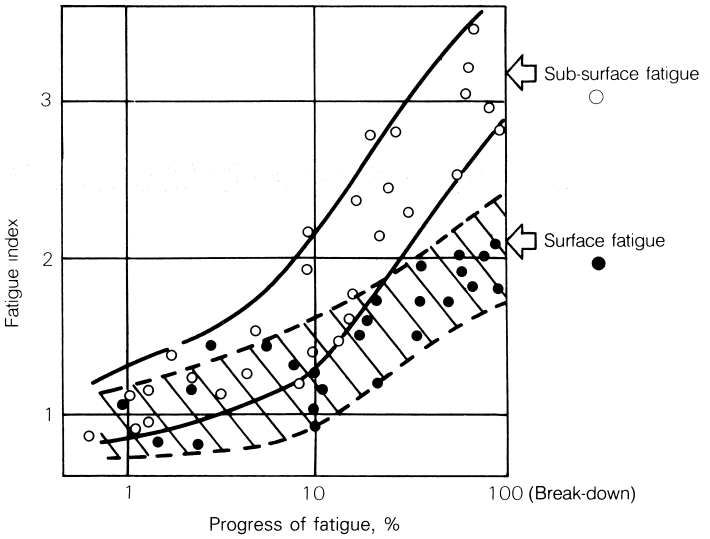



Fig. 12.6 Fatigue Progress and Fatigue Index

### (2) Surface and Sub-Surface Fatigues

Rolling bearings have an extremely smooth finish surface and enjoy relatively satisfactory lubrication conditions. It has been considered that internal shearing stress below the rolling surface governs the failure of a bearing.
Shearing stress caused by rolling contact becomes maximum at a certain depth below the surface, with a crack (which is an origin of break-down) occurring initially under the surface. When the raceway is broken due to such sub-surface fatigue, the fatigue index as measured in the depth direction is known to increase according to the theoretical calculation of shearing stress, as is evident from an example of the ball bearing shown in Fig. 12.7.
The fatigue pattern shown in Fig. 12.7 occurs mostly when lubrication conditions are satisfactory and oil film of sufficient thickness is formed in rolling contact points. The basic dynamic load rating described in the bearing catalog is determined using data of bearing failures according to the above internal fatigue pattern. Fig. 12.8 shows an example of a cylindrical roller bearing subject to endurance test under lubrication conditions causing unsatisfactory oil film. It is evident that the surface fatigue degree rises much earlier than the calculated life.
In this test, all bearings failed before sub-surface fatigue became apparent. In this way, bearing failure due to surface fatigue is mostly attributed to lubrication conditions such as insufficient oil film due to excessively low oil viscosity or entry of foreign matters or moisture into lubricant.

Needless to say, bearing failure induced by surface fatigue occurs in advance of that by sub-surface fatigue. Bearings in many machines are exposed frequently to danger of initiating such surface fatigue and, in most of the cases, failure by surface fatigue prior to failure due to sub-surface fatigue (which is the original life limit of bearings).
Fatigue analysis of bearings used in actual machines shows not the sub-surface fatigue pattern, but the surface fatigue pattern as shown in the figure in overwhelmingly high percentage.
In this manner, knowing the distribution of the fatigue index in actually used bearings leads to an understanding of effective information not only on residual life of bearings, but also on lubrication and load conditions.

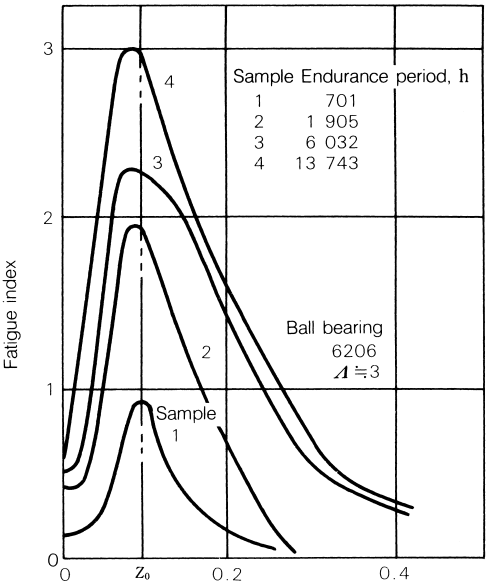



Fig. 12.7 Progress of Sub-Surface Fatigue

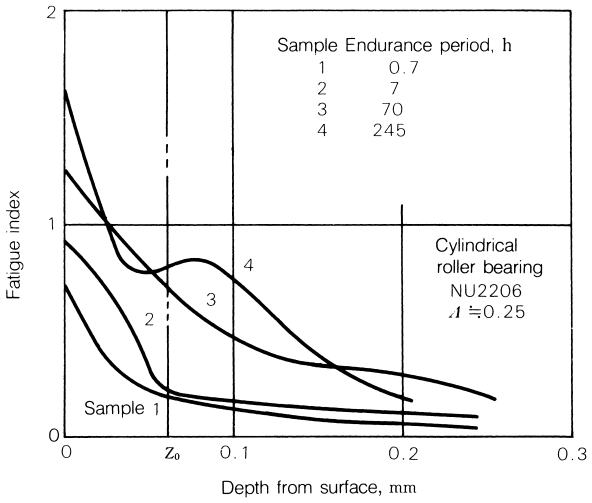



Fig. 12.8 Progress of Surface Fatigue

### 12.4.5 Hi-TF Bearings and Super-TF Bearings

#### (1) Hi-TF Bearings, Super-TF Bearings, and TF Technology

In its quest for longer bearing service life, NSK has spent many years analyzing the mechanisms of fatigue in bearings and researching and developing materials, heat treatment processes and operating conditions. The range of approaches to achieving longer service life taken by our research team are shown in Fig. 12.9. The technology incorporated in our Hi-TF Bearings and Super-TF Bearings is designed to maximize service life under conditions where bearings are subject to surfaceoriginating flaking.

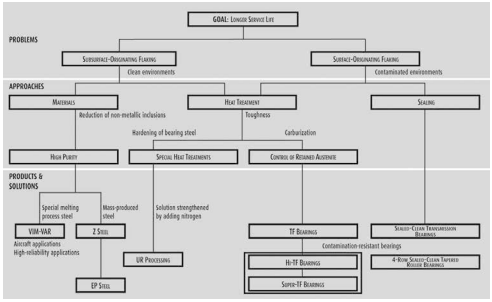



Fig. 12.9 Approaches to Achieving Longer Service Life in Bearings

#### (2) TF Technology

Bearings may be required to operate under clean or dirty conditions; under dirty conditions their lubricating oil is easily contaminated. Metal particles or casting sand in the lubricating oil make dents in the contact surfaces. As shown in Fig. 12.10, stress is concentrated around these dents and eventually leads to cracking and to surface-originating flaking. The concentration of stress around a dent is expressed by the equation $[P/P_0 \propto (r/c)^{-0.24}]$, where "r" is the radius at the shoulder of the dent and "2c" is the shoulder-to-shoulder width of the dent. The greater the value of "r/c", the smaller the stress concentration and the longer the service life of the bearing.

NSK is a world leader in the research and development of material properties to reduce the concentration of stress around surface dents. As shown in Fig. 12.11, our work has revealed that a high level of retained austenite is an extremely effective means of maximizing the r/c value around surface dents in the bearing material. TF technology is a unique heat treatment process developed by NSK to optimize the level of retained austenite in bearing materials.

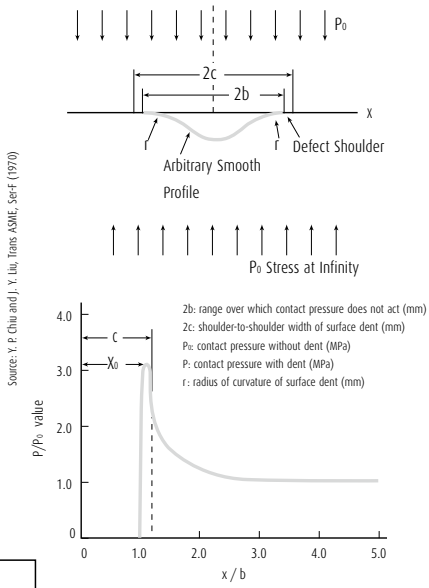



Fig. 12.10 Concentration of Stress around a Surface Dent

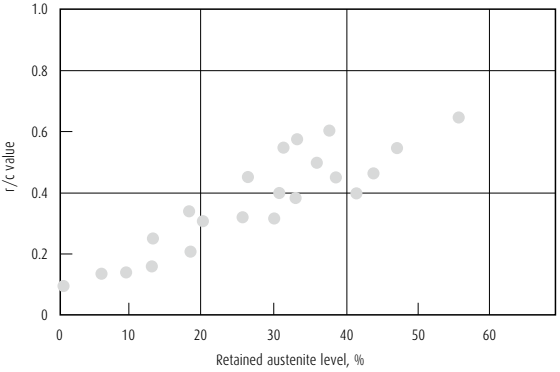



Fig. 12.11 Relationship of r/c Value to Retained Austenite Level

### (3) Material Properties of Hi-TF Bearings and Super-TF Bearings

NSK has developed the Hi-TF Bearings and Super-TF Bearings as two series of bearings that offer longer service life exceeding that of TF Bearings. As we have seen, the approach to achieving long service life taken in the Super-TF Bearings is to minimize the concentration of stress around the shoulders of surface dents. A high level of retained austenite helps to maximize the value of r/c and reduce the concentration of stress around the dents. However, austenite itself has a soft microstructure, and reduces the hardness of the bearing material. In order to meet the seemingly conflicting needs for greater hardness of the bearing material and a higher level of retained austenite, we decided to adopt a technique that would both promote the uniform distribution and reduce the diameter of carbide and carbonitride particles in the bearing material.

To this end, our researchers have developed a new type of steel that has added the proper quantity of element used in the formation of carbides, and have developed the carbonitriding heat treatment to extract minute carbide and nitride compulsorily for the first time in the world. Hi-TF Bearings adopt a new type of steel named SAC1, which has a specific amount of chrome added to it. Super-TF Bearings adopt a new type of steel named SAC2, which has a specific amount of chrome and molybdenum added to it. Although Super-TF Bearings have a slightly higher product cost than conventional bearings, rise in product cost for the Hi-TF Bearings was avoided by using chrome manganese steel (SAC1) for the material. Figures 12.12 and 12.13 illustrate the image analysis results of carbide distribution in the structures of Super-TF Bearings and an ordinary carburized steel bearing. It is clear that the Super-TF Bearings has a greater amount of fine-size carbide and carbonitride particles. Fig. 12.14 shows that the formations of finer carbide and carbonitride particle give Hi-TF Bearings and Super-TF Bearings a greater degree of hardness and higher retained austenite levels than those of TF Bearings. As a result, Hi-TF Bearings and Super-TF Bearings achieve a higher r/c value. (Fig. 12.15)

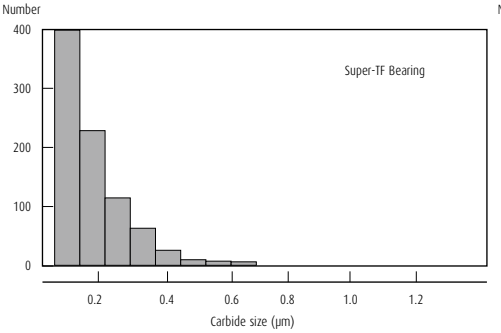



Fig. 12.12 Average Diameter of Carbide and Carbonitride Particles in a Super-TF Bearing

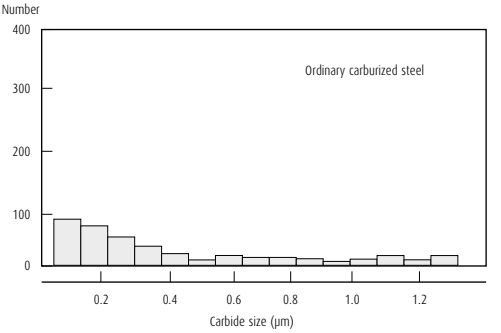



Fig. 12.13 Average Diameter of Carbide Particles in an Ordinary Carburized Steel Bearing

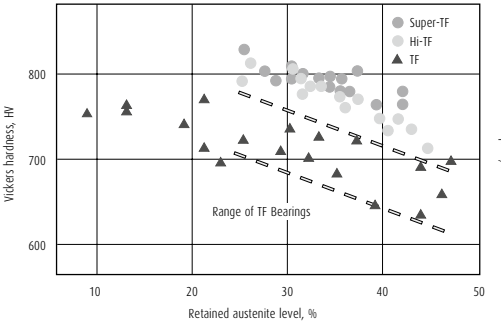



Fig. 12.14 Relationship of Material Hardness and Retained Austenite Level

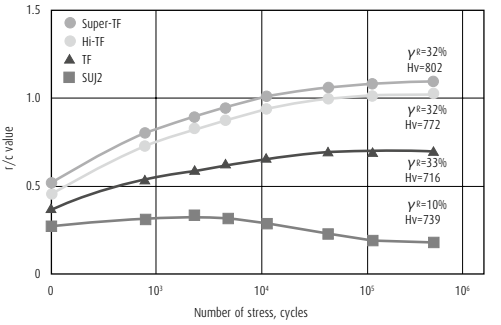



Fig. 12.15 Change of r/c Value under Repeated Stress

### (4) Service Life under Contaminated Lubrication Conditions

Table 12.10 and Fig. 12.17 show the results of service life tests conducted under contaminated lubrication conditions with NSK L44649/10 tapered roller bearings. If the service life of an ordinary carburized steel bearing of this type is taken as 1, then the $L_{10}$ life of TF, Hi-TF, and Super-TF Bearings would be 4.5, 7.1, and 10.2 respectively (Table 12.10). Hi-TF Bearings and Super-TF Bearings thus offer over seven time and ten times the service life of ordinary carburized steel bearings. Service life is generally affected both by the conditions in which the bearing is used and by the amount of contamination in the lubricant. Under contaminated lubricated conditions, service life may fall to as little as 1/5 of the catalog life.

As a result of attempting longer service life under contaminated lubrication, Hi-TF Bearings and Super-TF Bearings can achieve service life that exceeds the catalog life of existing products under contaminated lubrication for the first time.

| Ordinary carburized steel | TF | Hi-TF | Super-TF |
|---|---|---|---|
| 1 | 4.5 | 7.1 | 10.2 |

Table 12.10 Comparison of Service Life of L44649/10 Tapered Roller Bearings

### (5) Service Life under Clean Lubrication Conditions

Fig. 12.18 shows the result of service life tests under clean lubrication conditions using 6206 deep groove ball bearings. Under clean lubrication, Hi-TF Bearings and Super-TF Bearings show a slightly longer service life than those made of SUJ2. The most important factor is the cleanliness of the steel from which the bearing is made. Material with a greater degree of purity offers a greater degree of long-life performance.

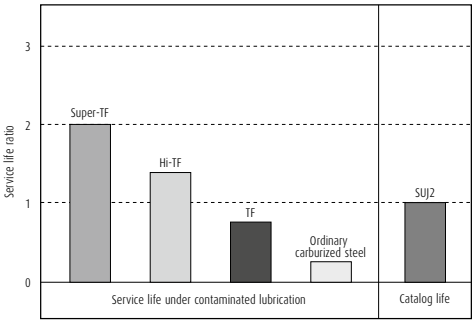



Fig. 12.16 Comparison of Service Life under Contaminated Lubrication

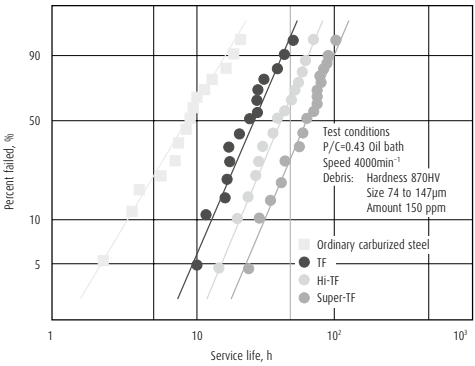



Fig. 12.17 Service Life of L44649/10 Bearings under Contaminated Lubrication

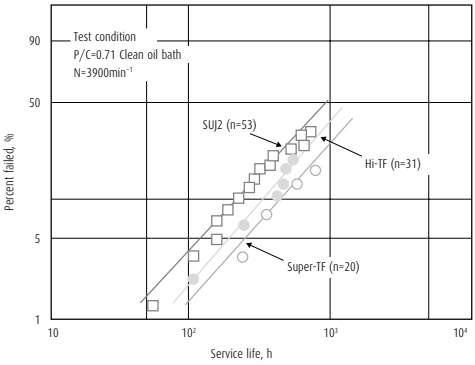



Fig. 12.18 Service Life Tests of 6206 Bearings under Clean Lubrication

## (6) Service Life under Boundary Lubrication Conditions

Under boundary lubrication conditions where there is an insufficient amount of EHL film, metal-to-metal contact occurs, thus reducing bearing life. Fig. 12.19 shows the results of service life tests conducted under conditions where oil film parameter $\Lambda$, which represents the ratio of the thickness of the oil film to the roughness of the surface, is very small ($\Lambda$=0.3). When $\Lambda$ is very small, peeling damage occurs (Fig. 12.20), but in Hi-TF Bearings and Super-TF Bearings, the concentration of stress around the projections of the contact area is reduced, giving a service life approximately 4.7 times and 5.5 times greater than that of ordinary carburized steel bearings.

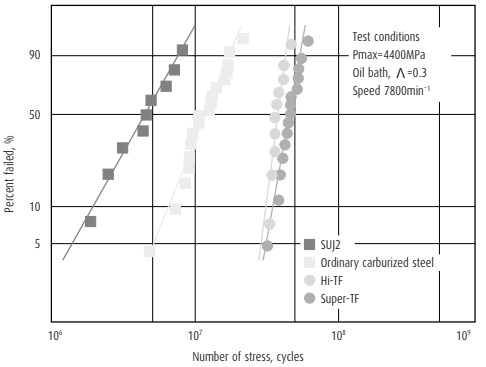


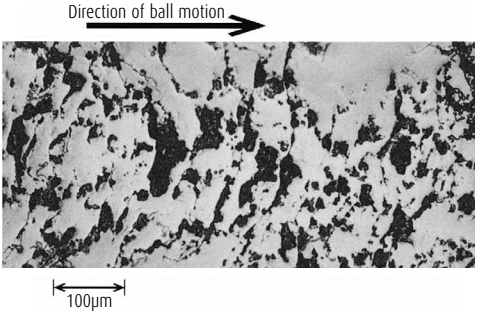

Fig. 12.19 Service Life Tests under Boundary Lubrication Conditions

## (7) Wear and Seizure Resistance

Besides extending service life under contaminated lubrication conditions, another goal is to increase the bearing's resistance to wear and seizure by ensuring the dispersion of a large number of fine carbides and nitrides in the bearing material. Fig. 12.21 presents the results of a Sawin-type wear test, showing the degree of wear and the seizure limit for different types of bearing material. The test reveals that Hi-TF Bearings and Super-TF Bearings have superior wear resistance to both SUJ2 steel and TF Bearings. Hi-TF Bearings and Super-TF Bearings are also 20% and 40% more resistant to seizure than both SUJ2 steel and TF Bearings.

## (8) Heat Resistance

Fig. 12.22 shows the results of service life tests conducted with 6206 ball bearings at 160°C under clean lubrication conditions. Test results reveal that Super-TF Bearings (heat-resistant specifications) have approximately 4 times the service life of SUJ2X26 steel bearings.



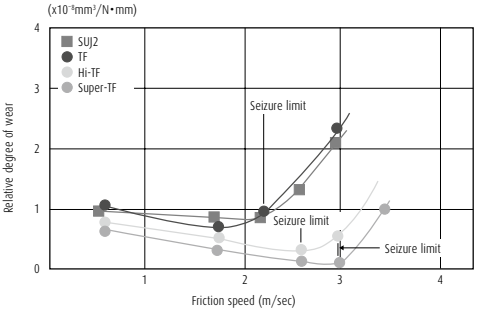




Fig. 12.21 Comparison of Wear Resistance

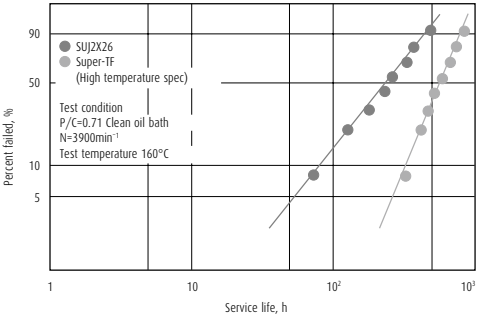



Fig. 12.22 Service Life Test of 6206 under High Temperature Clean Lubrication

### 12.4.6 Physical Properties of Representative Polymers Used as Bearing Material

Because of lightweight, easy formability, and high corrosion resistance, polymer materials are used widely as a material for cages. Polymers may be used independently, but they are usually combined with functional fillers to form a composite material. Composites can be customized to have specific properties. In this way composites can be designed to be bearing materials. For example, fillers can be used to improve such properties as low friction, low wear, non-stick slip characteristic, high limit PV value, non-scrubbing of counterpart material, mechanical properties, and heat resistance, etc.

Table 12.11 shows characteristics of representative polymer materials used for bearings.

| Plastics | Elastic modulus (GPa) (1) |
|---|---|
| Polyethylene | |
| HDPE | 0.11 |
| UHMWPE | 50.5 |
| Polyamide | |
| Nylon 6 | 2.5 |
| Nylon 66 | 3.0 |
| Nylon 11 | 1.25 |
| Polytetra fluoroethylene | |
| PTFE | 0.40 |
| Poly buthylene terephthalate | |
| PBT | 2.7 |
| Polyacetal POM | |
| Homo-polymer | 3.2 |
| Co-polymer | 2.9 |
| Polyether sulfon | |
| PES | 2.46 |
| Polysulfon | |
| PSf | 2.5 |
| Polyallylate (Aromatic polyester) | 1.3<br>3.0 |
| Polyphenylene sulfide PPS (GF 40%) | 4.2 |
| Polyether ether keton PEEK | 1.7 |
| Poly-meta-phenylene isophthalic amide | 10 (fiber)<br>7.7 (moid) |
| Polypromellitic imide (Aromatic polyimide) PI | 3 (film)<br>2.5 to 3.2 (mold) |
| Polyamide imide PAI | 4.7 |
| Polyether imide (Aromatic polyimide) PI | 3.6 |
| Polyamino bis-maleimide | — |

## Table 12.11 Characteristics of Representative Polymers

| Strength GPa (1) | Density g/cm³ | Specific elastic modulus ×10⁴mm | Specific strength ×10⁴mm | Melting point °C | Glass transition temp °C | Thermal deformation temperature °C (2) | Continuous operating temperature °C | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0.03<br>0.025 | 0.96<br>0.94 | 12.6<br>53.2 | 3.3<br>2.7 | 132<br>136 | -20<br>-20 | 75/50<br>75/50 | —<br>— | High creep and toughness, softening |
| 0.07<br>0.08 | 1.13<br>1.14 | 221.2<br>263.2 | 6.2<br>7.0 | 215<br>264 | 50<br>60 | 150/57<br>180/60 | 80 to 120<br>80 to 120 | High water absorption and toughness |
| 0.04 | 1.04 | 120.2 | 3.8 | 180 | — | 150/55 | Lower than nylon 6 or 66 | Low water absorption |
| 0.028 | 2.16 | 18.5 | 1.3 | 327 | 115 | 120/ — | 260 | High creep, sintering,low friction and adhesion, inert. Stable at 290° |
| 0.06 | 1.31 | 206.1 | 4.6 | 225 | 30 | 230/215 | 155 | |
| 0.07<br>0.06 | 1.42<br>1.41 | 225.3<br>205.7 | 4.9<br>4.3 | 175<br>165 | -13<br>— | 170/120<br>155/110 | —<br>104 | High hardness and toughness, low water absorption |
| 0.086 | 1.37 | 179.6 | 6.3 | — | 225 | 210/203 | 180 | Usable up to 200°C Chemically stable |
| 0.07 | 1.24 | 201.6 | 5.6 | — | 190 | 181/175 | 150 | |
| 0.07<br>0.075 | 1.35<br>1.40 | 96.3<br>214.3 | 5.2<br>5.4 | 350<br>350 | —<br>— | 293<br>293 | 300<br>260 to 300 | Inert, high hardness, Used as filler for PTFE Stable up to 320° |
| 0.14 | 1.64 | 256.1 | 8.5 | 275 | 94 | >260 | 220 | Hot cured at 360° |
| 0.093 | 1.30 | 130.8 | 7.2 | 335 | 144 | 152 | 240 | |
| 0.7<br>0.18 | 1.38<br>1.33 | 724.6<br>579 | 50.7<br>13.5 | 375<br>415<br>(decomposition) | >230<br>>230 | 280<br>280 | 220<br>220 | Fire retardant, heat resistance fiber |
| 0.17 | 1.43 | 203 | 7.0 | Heat decomposition | 417 decomposition | 360/250 | 300 (3) | No change in inert gas up to 350° |
| 0.1 | 1.43 | 203 | 7.0 | Heat decomposition | 417 decomposition | 360/250 | 260 | Usable up to 300°C for bearing. Sintering, no fusion (molded products) |
| 0.2 | 1.41 | 333.3 | 14.2 | — | 280 | 260 | 210 | Usable up to 290°C as adhesive or enamel Improved polyimide of melting forming |
| 0.107 | 1.27 | 240.9 | — | — | 215 | 210/200 | 170 | Improved polyimide of melting forming |
| 0.35 | 1.6 | — | 21.9 | — | — | 330(3) | 260 | |

**Notes** (1) GPa ≒ $10^4$ kgf/cm² = $10^2$ kgf/mm²

(2) If there is a slash mark " / " in the thermal deformation temperature column, then the value to the left of the " / " applies to 451 kPa, If there, the value relates to 1.82 MPa.

(3) Reference value

### 12.4.7 Characteristics of Nylon Material for Cages

In various bearings these days, plastic cages have come to replace metal cages increasingly. Advantages of using plastic cages may be summarized as follows:

(1) Lightweight and favorable for use with highspeed rotation

(2) Self-lubricating and low wear. Worn powders are usually not produced when plastic cages are used. As a result, a highly clean internal state is maintained.

(3) Low noise appropriate atm silent environments

(4) Highly corrosion resistant, without rusting

(5) Highly shock resistant, proving durable under high moment loading

(6) Easy molding of complicated shapes, ensures high freedom for selection of cage shape. Thus better cage performance can be obtained.

As to disadvantages when compared with metal cages, plastic cages have low heat resistance and limited operating temperature range (normally 120°C). Due attention is also necessary for use because plastic cages are sensitive to certain chemicals. Polyamide resin is a representative plastic cage material. Among polyamide resins, nylon 66 is used in large quantity because of its high heat resistance and mechanical properties.

Polyamide resin contains the amide coupling (-NHCO-) with hydrogen bonding capability in the molecular chain and is characterized by its regulation of mechanical properties and water absorption according to the concentration and hydrogen bonding state. High water absorption (Fig. 12.23) of nylon 66 is generally regarded as a shortcoming because it causes dimensional distortion or deterioration of rigidity. On the other hand, however, water absorption helps enhance flexibility and prevents cage damage during bearing assembly when a cage is required to have a substantial holding interference for the rolling elements. This also causes improvement is toughness which is effective for shock absorption during use. In this way, a so-called shortcoming may be considered as an advantage under certain conditions. Nylon can be improved substantially in strength and heat resistance by adding a small amount of fiber. Therefore, materials reinforced by glass fiber may be used depending on the cage type and application.

In view of maintaining deformation of the cage during assembly of bearings, it is common to use a relatively small amount of glass fiber to reinforce the cage. (Table 12.12) Nylon 66 demonstrates vastly superior performance under mild operating conditions and has wide application possibilities as a mainstream plastic cage material. However, it often develops sudden deterioration under severe conditions (in high temperature oil, etc.). Therefore, due attention should be paid to this material during practical operation.

As an example, Table 12.13 shows the time necessary for the endurance performance of various nylon 66 materials to drop to 50% of the initial value under several different cases. Material deterioration in oil varies depending on the kind of oil. Deterioration is

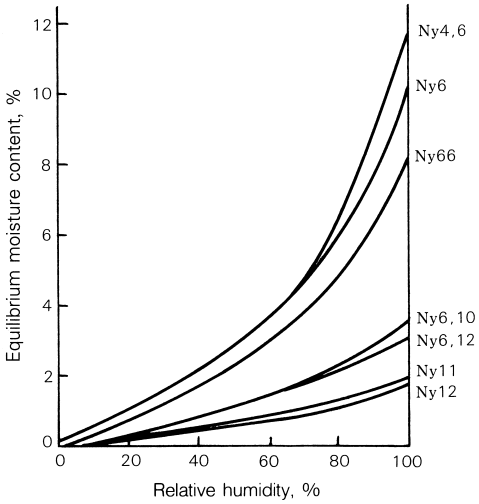



Fig. 12.23 Equilibrium Moisture Content and Relative Humidity of Various Nylons

excessive if the oil contains an extreme-pressure agent. It is known that sulfurous extreme-pressure agents accelerate deterioration more than phosphorous extreme-pressure agents and such deterioration occurs more rapidly with rising temperatures.

On the other hand, material deteriorates less in grease or air than in oil. Besides, materials reinforced with glass fiber can suppress deterioration of the strength through material deterioration by means of the reinforcement effect of glass fibers, thereby, helping to extend the durability period.

## Table 12.12 Examples of Applications with Fiber Reinforced Nylon Cages

| | Bearing type | Main aplication | Cage material |
|---|---|---|---|
| Ball bearing | Miniature ball bearings | VCR, IC cooling fans | Nylon 66 (Glass fiber content: 0 to 10%) |
| | Deep groove ball bearings | Alternators, fan motors for air conditioners | |
| | Angular contact ball bearings | Magnetic clutches, automotive wheels | |
| Roller bearing | Needle roller bearings | Automotive transmissions | Nylon 66 (Glass fiber content: 10 to 25%) |
| | Tapered roller bearings | Automotive wheels | |
| | ET-type cylindrical roller bearings | General | |
| | H-type spherical roller bearings | General | |

## Table 12.13 Environmental Resistance of Nylon 66 Resin

| Environment | | Temperature, °C | Glass content | Hours for the physical property value to drop to 50%, h (500 / 1000 / 1500 / 2000) | Remarks |
|---|---|---|---|---|---|
| Oil | Gear oil | 120 | 0 D | | Contains an extreme pressure additive |
| | | 140 | 0 A D | | |
| | Synthetic lubricating oil | 100 | A | | Contains an extreme pressure additive |
| | | 120 | A | | |
| | | 130 | 0 A C | | |
| | | 150 | 0 B D | | |
| | Hydraulic oil | 80 | 0 D | | Contains an extreme pressure additive |
| | | 120 | 0 D | | |
| | | 150 | 0 D | | |
| | ATF oil | 120 | 0 D | | |
| | | 140 | 0 A D | | |
| | Engine oil | 120 | 0 D | | |
| Grease | | 80 | 0 D | | |
| | | 120 | 0 D | | |
| | | 130 | A D | | |
| Air | | 160 | 0 A C | | |
| | | 180 | 0 B | | |

Class content: A<B<C<D

### 12.4.8 Heat-Resistant Resin Materials for Cages

Currently, polyamide resin shows superior performance under medium operating environmental conditions. This feature plus its relative inexpensiveness lead to its use in increasing quantities. But, the material suffers from secular material deterioration or aging which creates a practical problem during continuous use at 120°C or more or under constant or intermittent contact with either oils (containing an extreme pressure agent) or acids.

Super-engineering plastics should be used for the cage materials of bearings running in severe environments such as high temperature over 150°C or corrosive chemicals. Though super-engineering plastics have good material properties like heat resistance, chemical resistance, rigidity at high temperature, mechanical strength, they have problems with characteristics required for the cage materials like toughness when molding or bearing assembling, weld strength, fatigue resistance. Also, the material cost is expensive. Table 12.14 shows the evaluation results of typical superengineering plastics, which can be injection molded into cage shapes.

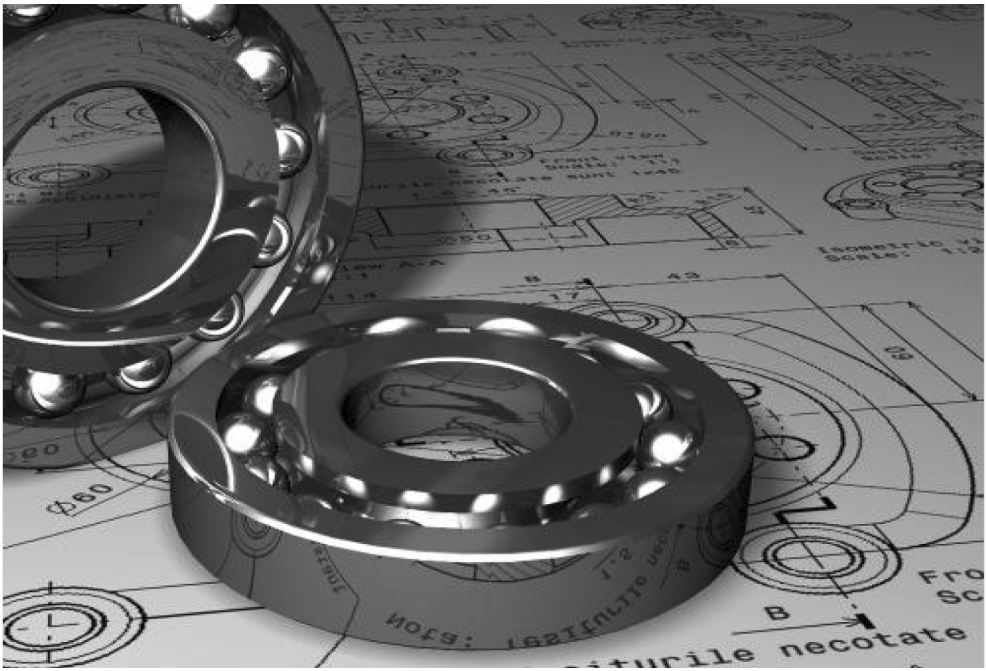
Among the materials in Table 12.14, though the branch type polyphenylene sulfide (PPS) is popularly used, the cage design is restricted since forced-removal from the die is difficult due to poor toughness and brittleness. Moreover, PPS is not always good as a cage material, since the claw, stay, ring, or flange of the cage is easily broken on the bearing assembling line. On the other hand, the heat resistant plastic cage developed by NSK, is made of linear-chain high molecules which have been polymerized from molecular chains. These molecular chains do not contain branch or crosslinking so they have high toughness compared to the former material (branch type PPS). Linear PPS is not only superior in heat resistance, oil resistance, and chemical resistance, but also has good mechanical characteristics such as snap fitting (an important characteristic for cages), and high temperature rigidity.

NSK has reduced the disadvantages associated with linear PPS: difficulty of removing from the die and slow crystallization speed, thereby establishing it as a material suitable for cages. Thus, linear PPS is thought to satisfy the required capabilities for a heat resistant cage material considering the relation between the cost and performance.

| Classification | Polyether sulfone (PES) |
|---|---|
| Resin | Amorphous resin |
| Continuous temp | 180°C |
| Physical properties | › Poor toughness (Pay attention to cage shape)<br>› Low weld strength<br>› Small fatigue resistance |
| Environmental properties | › Water absorption (Poor dimensional stability)<br>› Good aging resistance<br>› Poor stress cracking resistance |
| Material cost (Superiority) | 3 |
| Cage application | › Many performance problems<br>› High material price |

## Table 12.14 Properties of Typical Super-Engineering Plastic Materials for Cages

| | Polyether imide (PEI) | Polyamide imide (PAI) | Polyether etherketon (PEEK) | Branch type polyphenylene sulfide (PPS) | Linear type polyphenylene sulfide (L-PPS) |
|---|---|---|---|---|---|
| | Amorphous resin | Amorphous resin | Crystalline resin | Crystalline resin | Crystalline resin |
| | 170°C | 210°C | 240°C | 220°C | 220°C |
| | › Poor toughness (Pay attention to cage shape)<br>› Low weld strength<br>› Small fatigue resistance | › Very brittle (No forced-removal molding)<br>› Special heat treatment before use<br>› High rigidity, after heat treatment | › Excellent toughness, wear and fatigue resistance<br>› Small fatigue resistance | › Excellent mechanical properties<br>› Slightly low toughness | › Excellent mechanical properties<br>› Good toughness<br>› Good dimensional stability (No water absorption) |
| | › Good aging resistance<br>› Poor stress cracking resistance | › Good environment resistance | › Good environment resistance | › Good environment resistance | › Good environment resistance (Not affected by most chemicals. Doesn't deteriorate in high temperature oil with extreme pressure additives). |
| | 2 | 5 | 4 | 1 | 1 |
| | › Many performance problems<br>› High material cost | › Good performance<br>› High material and molding cost (For special applications) | › Excellent performance<br>› High material cost (For special applications) | › Problems with toughness<br>› Cost is high compared to its performance | › Reasonable cost for its performance (For general applications) |



## 13. DESIGN OF SHAFTS AND HOUSINGS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13.3 Bearing Seals ····· A 272
13.3.1 Non-Contact Types Seals ····· A 272
(1) Oil Groove Seals ····· A 272
(2) Flinger (Slinger) Type Seals ····· A 273
(3) Labyrinth Seals ····· A 273
13.3.2 Contact Type Seals ····· A 274
(1) Oil Seals ····· A 274
(2) Felt Seals ····· A 275

## 13.1 Accuracy and Surface Finish of Shafts and Housings

If the accuracy of a shaft or housing does not meet the specification, the performance of the bearings will be affected and they will not provide their full capability. For example, inaccuracy in the squareness of the shaft shoulder may cause misalignment of the bearing inner and outer rings, which may reduce the bearing fatigue life by adding an edge load in addition to the normal load. Cage fracture and seizure sometimes occur for this same reason. Housings should be rigid in order to provide firm bearing support. High rigidity housings are advantageous also from he standpoint of noise, load distribution, etc.

For normal operating conditions, a turned finish or smooth bored finish is sufficient for the fitting surface; however, a ground finish is necessary for applications where vibration and noise must be low or where heavy loads are applied.

In cases where two or more bearings are mounted in one single-piece housing, the fitting surfaces of the housing bore should be designed so both bearing seats may be finished together with one operation such as in-line boring. In the case of split housings, care must be taken in the fabrication of the housing so the outer ring will not become deformed during installation. The accuracy and surface finish of shafts and housings are listed in Table 11.1 for normal operating conditions.

### Table 13.1 Accuracy and Roughness of Shaft and Housing

| Item | Class of Bearings | | Shaft | Housing Bore |
|---|---|---|---|---|
| Tolerance for Out-of-roundness | Normal, | Class 6 | $\frac{IT3}{2}$ to $\frac{IT4}{2}$ | $\frac{IT4}{2}$ to $\frac{IT5}{2}$ |
| | Class 5, | Class 4 | $\frac{IT2}{2}$ to $\frac{IT3}{2}$ | $\frac{IT2}{2}$ to $\frac{IT3}{2}$ |
| Tolerance for Cylindricality | Normal, | Class 6 | $\frac{IT3}{2}$ to $\frac{IT4}{2}$ | $\frac{IT4}{2}$ to $\frac{IT5}{2}$ |
| | Class 5, | Class 4 | $\frac{IT2}{2}$ to $\frac{IT3}{2}$ | $\frac{IT2}{2}$ to $\frac{IT3}{2}$ |
| Tolerance for Shoulder Runout | Normal, | Class 6 | IT3 | IT3 to IT4 |
| | Class 5, | Class 4 | IT3 | IT3 |
| Roughness of Fitting Surfaces $R_a$ | Small Bearings | | 0.8 | 1.6 |
| | Large Bearings | | 1.6 | 3.2 |

**Remarks** This table is for general recommendation using radius measuring method, the basic tolerance (IT) class should be selected in accordance with the bearing precision class. Regarding the figures of IT, please refer to the Appendix Table 11 (page C016). In cases that the outer ring is mounted in the housing bore with interference or that a thin cross-section bearing is mounted on a shaft and housing, the accuracy of the shaft and housing should be higher since this affects the bearing raceway directly.

## 13.2 Shoulder and Fillet Dimensions

The shoulders of the shaft or housing in contact with the face of a bearing must be perpendicular to the shaft center line (Refer to Table 13.1). The front face side shoulder bore of the housing for a tapered roller bearing should be parallel with the bearing axis in order to avoid interference with the cage.

The fillets of the shaft and housing should not come in contact with the bearing chamfer; therefore, the fillet radius $r_a$ must be smaller than the minimum bearing chamfer dimension r or $r_1$.

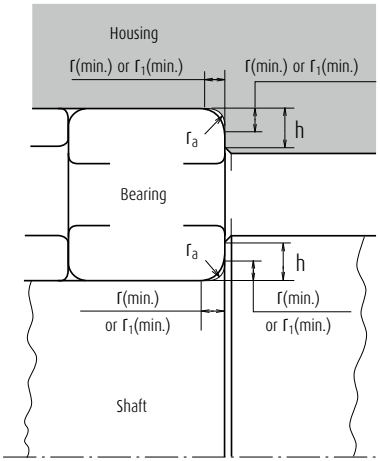



Fig. 13.1 Chamfer Dimensions, Fillet Radius ofShaft and Housing, and Shoulder Height

The shoulder heights for both shafts and housings for radial bearings should be sufficient to provide good support over the face of the bearings, but enough face should extend beyond the shoulder to permit use of special dismounting tools. The recommended minimum shoulder heights for metric series radial bearings are listed in Table 13.2.

Nominal dimensions associated with bearing mounting are listed in the bearing tables including the proper shoulder diameters. Sufficient shoulder height is particularly important for supporting the side ribs of tapered roller bearings and cylindrical roller bearings subjected to high axial loads.

The values of h and $r_a$ in Table 13.2 should be adopted in those cases where the fillet radius of the shaft or housing is as shown in Fig. 13.2 (a), while the values in Table 13.3 are generally used with an undercut fillet radius produced when grinding the shaft as shown in Fig. 13.2 (b).

## Table 13.2 Recommended Minimum Shoulder Heights for Use with Metric Series Radial Bearings

Units : mm

| Nominal Chamfer Dimensions r (min.) or $r_1$ (min.) | Shaft or Housing | | |
|---|---|---|---|
| | Fillet Radius $r_a$ (max.) | Minimun Shoulder Heights h (min.) | |
| | | Deep Groove Ball Bearings, Self-Aligning Ball Bearings, Cylindrical Roller Bearings, Solid Needle Roller Bearings | Angular Contact Ball Bearings, Tapered Roller Bearings, Spherical Roller Bearings |
| 0.05 | 0.05 | 0.2 | – |
| 0.08 | 0.08 | 0.3 | – |
| 0.1 | 0.1 | 0.4 | – |
| 0.15 | 0.15 | 0.6 | – |
| 0.2 | 0.2 | 0.8 | – |
| 0.3 | 0.3 | 1 | 1.25 |
| 0.6 | 0.6 | 2 | 2.5 |
| 1 | 1 | 2.5 | 3 |
| 1.1 | 1 | 3.25 | 3.5 |
| 1.5 | 1.5 | 4 | 4.5 |
| 2 | 2 | 4.5 | 5 |
| 2.1 | 2 | 5.5 | 6 |
| 2.5 | 2 | – | 6 |
| 3 | 2.5 | 6.5 | 7 |
| 4 | 3 | 8 | 9 |
| 5 | 4 | 10 | 11 |
| 6 | 5 | 13 | 14 |
| 7.5 | 6 | 16 | 18 |
| 9.5 | 8 | 20 | 22 |
| 12 | 10 | 24 | 27 |
| 15 | 12 | 29 | 32 |
| 19 | 15 | 38 | 42 |

**Remarks**

1. When heavy axial loads are applied, the shoulder height must be sufficiently higher than the values listed.
2. The fillet radius of the corner is also applicable to thrust bearings.
3. The shoulder diameter is listed instead of shoulder height in the bearing tables.

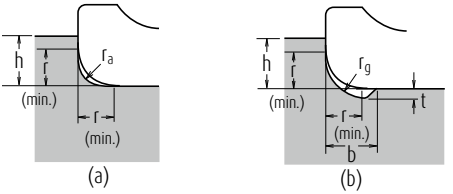



Fig. 13.2 Chamfer Dimensions, Fillet Radius, and Shoulder Height

## Table 13.3 Shaft Undercut

Units : mm

| Chamfer Dimensions of Inner and Outer Rings r (min.) or $r_1$ (min.) | Undercut Dimensions | | |
|---|---|---|---|
| | t | $r_g$ | b |
| 1 | 0.2 | 1.3 | 2 |
| 1.1 | 0.3 | 1.5 | 2.4 |
| 1.5 | 0.4 | 2 | 3.2 |
| 2 | 0.5 | 2.5 | 4 |
| 2.1 | 0.5 | 2.5 | 4 |
| 2.5 | 0.5 | 2.5 | 4 |
| 3 | 0.5 | 3 | 4.7 |
| 4 | 0.5 | 4 | 5.9 |
| 5 | 0.6 | 5 | 7.4 |
| 6 | 0.6 | 6 | 8.6 |
| 7.5 | 0.6 | 7 | 10 |

For thrust bearings, the squareness and contact area of the supporting face for the bearing rings must be adequate. In the case of thrust ball bearings, the housing shoulder diameter $D_a$ should be less than the pitch circle diameter of the balls, and the shaft shoulder diameter $d_a$ should be greater than the pitch circle diameter of the balls (Fig. 13.3).

For thrust roller bearings, it is advisable for the full contact length between rollers and rings to be supported by the shaft and housing shoulder (Fig. 13.4).

These diameters $d_a$ and $D_a$ are listed in the bearing tables.

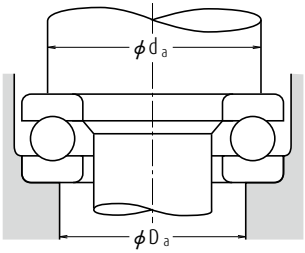



Fig. 13.3 Face Supporting Diameters for Thrust Ball Bearings

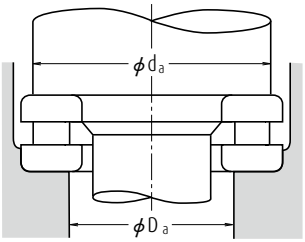



Fig. 13.4 Face Supporting Diameters for Thrust Roller Bearings

## 13.3 Bearing Seals

To insure the longest possible life of a bearing, it may be necessary to provide seals to prevent leakage of lubricant and entry of dust, water and other harmful material like metallic particles. The seals must be free from excessive running friction and the probability of seizure. They should also be easy to assemble and disassemble. It is necessary to select a suitable seal for each application considering the lubricating method.

### 13.3.1 Non-Contact Type Seals

Various sealing devices that do not contact the shaft, such as oil grooves, flingers, and labyrinths, are available. Satisfactory sealing can usually be obtained with such seals because of their close running clearance. Centrifugal force may also assist in preventing internal contamination and leakage of the lubricant.

#### (1) Oil Groove Seals

The effectiveness of oil groove seals is obtained by means of the small gap between the shaft and housing bore and by multiple grooves on either or both of the housing bore and shaft surface (Fig. 13.5 (a), (b)).

Since the use of oil grooves alone is not completely effective, except at low speeds, a flinger or labyrinth type seal is often combined with an oil groove seal (Fig. 13.5 (c)). The entry of dust is impeded by packing grease with a consistency of about 200 into the grooves.

The smaller the gap between the shaft and housing, the greater the sealing effect; however, the shaft and housing must not come in contact while running. The recommended gaps are given in Table 13.4.

The recommended groove width is approximately 3 to 5 mm, with a depth of about 4 to 5 mm. In the case of sealing methods using grooves only, there should be three or more grooves.

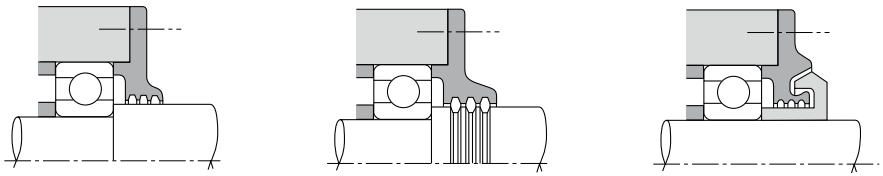



Fig. 13.5 Examples of Oil Grooves

### (2) Flinger (Slinger) Type Seals

A flinger is designed to force water and dust away by means of the centrifugal force acting on any contaminants on the shaft. Sealing mechanisms with flingers inside the housing as shown in Fig. 13.6 (a), (b) are mainly intended to prevent oil leakage, and are used in environments with relatively little dust. Dust and moisture are prevented from entering by the centrifugal force of flingers shown in Figs. 13.6 (c), (d).

### (3) Labyrinth Seals

Labyrinth seals are formed by interdigitated segments attached to the shaft and housing that are separated by a very small gap. They are particularly suitable for preventing oil leakage from the shaft at high speeds.

The type shown in Fig. 13.7 (a) is widely used because of its ease of assembly, but those shown in Figs. 13.7 (b), (c) have better seal effectiveness.

### Table 13.4 Gaps between Shafts and Housings for Oil-Groove Type Seals

Units : mm

| Nominal Shaft Diameter | Radial Gap |
|---|---|
| Under 50 | 0.25 to 0.4 |
| 50-200 | 0.5 to 1.5 |

### Table 13.5 Labyrinth Seal Gaps

Units : mm

| Nominal Shaft Diameter | Labyrinth Gaps | |
|---|---|---|
| | Radial Gap | Axial Gap |
| Under 50 | 0.25 to 0.4 | 1 to 2 |
| 50-200 | 0.5 to 1.5 | 2 to 5 |

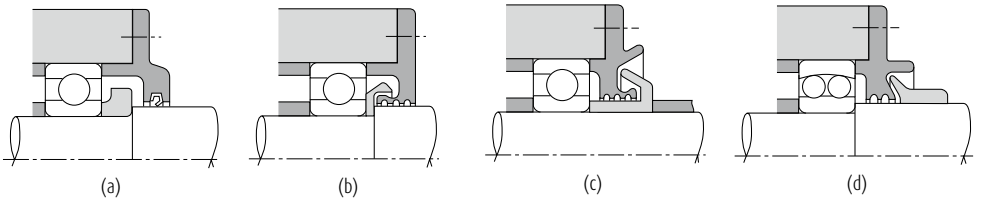



Fig. 13.6 Examples of Flinger Configurations

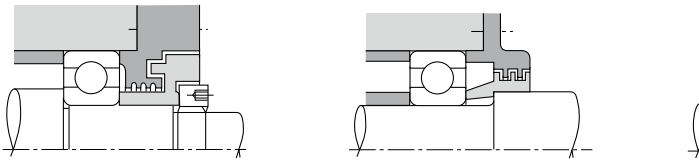



Fig. 13.7 Examples of Labyrinth Designs

### 13.3.2 Contact Type Seals

The effectiveness of contact seals is achieved by the physical contact between the shaft and seal, which may be made of synthetic rubber, synthetic resin, felt, etc. Oil seals with synthetic rubber lips are most frequently used.

#### (1) Oil Seals

Many types of oil seals are used to prevent lubricant from leaking out as well as to prevent dust, water, and other foreign matter from entering (Figs. 13.8 and 13.9).

In Japan, such oil seals are standardized (Refer to JIS B 2402) on the basis of type and size. Since many oil seals are equipped with circumferential springs to maintain adequate contact force, oil seals can follow the non-uniform rotational movement of a shaft to some degree.

Seal lip materials are usually synthetic rubber including nitrile, acrylate, silicone, and fluorine. Tetrafluoride ethylene is also used. The maximum allowable operating temperature for each material increases in this same order.

Synthetic rubber oil seals may cause trouble such as overheating, wear, and seizure, unless there is an oil film between the seal lip and shaft. Therefore, some lubricant should be applied to the seal lip when the seals are installed. It is also desirable for the lubricant inside the housing to spread a little between the sliding surfaces.

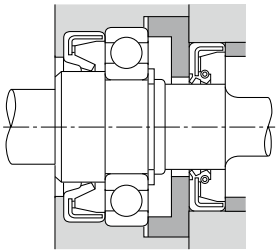


Fig. 13.8 Example of Application of Oil Seal (1)

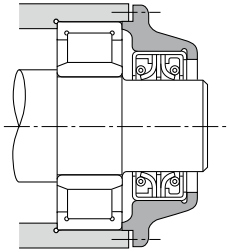


Fig. 13.9 Example of Application of Oil Seal (2)

However, please be aware that ester-based grease will cause acrylic rubber material to swell. Also, low aniline point mineral oil, silicone-based grease, and silicon-based oil will cause silicone-based material to swell. Moreover, urea-based grease will cause fluorine-based material to deteriorate.

The permissible circumferential speed for oil seals varies depending on the type, the finish of the shaft surface, liquid to be sealed, temperature, shaft eccentricity, etc. The temperature range for oil seals is restricted by the lip material. Approximate circumferential surface speeds and temperature permitted under favorable conditions are listed in Table 13.6.

When oil seals are used at high circumferential surface speed or under high internal pressure, the contact surface of the shaft must be smoothly finished and the shaft eccentricity should be less than 0.02 to 0.05 mm.

The hardness of the shaft's contact surface should be made higher than HRC 40 by means of heat treatment or hard chrome plating in order to gain abrasion resistance. If possible, a hardness of more than HRC 55 is recommended.

The approximate level of contact surface finish required for several shaft circumferential surface speeds is given in Table 13.7.

**Table 13.6 Permissible Circumferential Surface Speeds and Temperature Range for Oil Seals**

| Seal Materials | | Permissible Circumferential Speeds (m/sec) | Operating Temperature Range (°C) (1) |
|---|---|---|---|
| Synthetic Rubber | Nitrile Rubber | Under 16 | −25 to +100 |
| | Acrylic Rubber | Under 25 | −15 to +130 |
| | Silicone Rubber | Under 32 | −70 to +200 |
| | Fluoropolymer + rubber | Under 32 | −30 to +200 |
| Tetrafluoride Ethylene Resin | | Under 15 | −50 to +220 |

Note (1) The upper limit of the temperature range may be raised about 20 °C for operation for short intervals.

**Table 13.7 Shaft Circumferential Surface Speeds and Finish of Contact Surfaces**

| Circumferential Surface Speeds (m/s) | Surface Finish $R_a$ (μm) |
|---|---|
| Under 5 | 0.8 |
| 5 to 10 | 0.4 |
| Over 10 | 0.2 |

### (2) Felt Seals

Felt seals are one of the simplest and most common seals used for transmission shafts, etc.

However, since oil permeation and leakage are unavoidable if oil is used, this type of seal is used only for grease lubrication, primarily to prevent dust and other foreign matter from entering. Felt seals are not suitable for circumferential surface speeds exceeding 4 m/sec; therefore, it is preferable to replace them with synthetic rubber seals depending on the application.

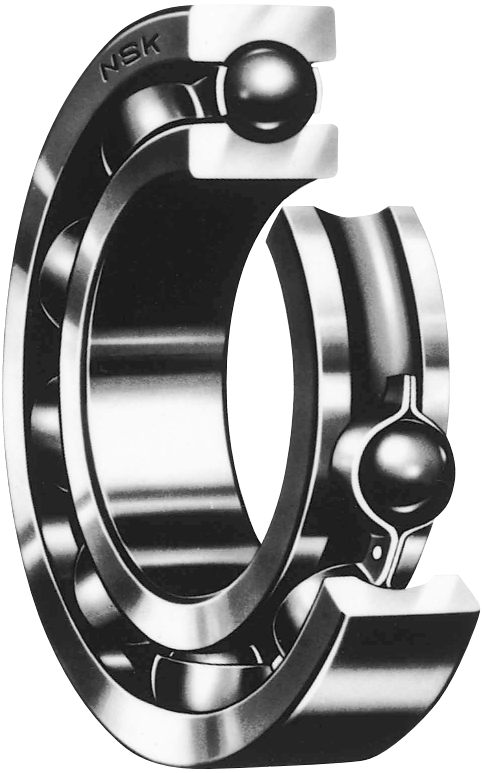
# BEARINGS TABLE



## Part B

## BEARINGS TABLE


1. Deep Groove Ball Bearings ..... B 005
2. Extra Small Ball Bearings and Miniature Ball Bearings ..... B 055
3. Angular Contact Ball Bearings ..... B 073
4. Self-Aligning Ball Bearings ..... B 119
5. Cylindrical Roller Bearings ..... B 141
6. Tapered Roller Bearings ..... B 199
7. Spherical Roller Bearings ..... B 275
8. Thrust Ball Bearings ..... B 313
9. Thrust Cylindrical Roller Bearings ..... B 331
10. Thrust Tapered Roller Bearings ..... B 339
11. Thrust Spherical Roller Bearings ..... B 349
12. Ball Bearing Units ..... B 359
13. Accessories for Rolling Bearings ..... B 375


NSK

## 1. DEEP GROOVE BALL BEARINGS


INTRODUCTION ..... B 006

TECHNICAL DATA

Radial and Axial Internal Clearances and Contact Angles for
Single-Row Deep Groove Ball Bearings ..... B 012
Features and Operating Temperature Range of Ball Bearing Seal Material ..... B 016
Free Space and Grease Filling Amount for Deep Groove Ball Bearings ..... B 018


### BEARINGS TABLE


SINGLE-ROW DEEP GROOVE BALL BEARINGS

| | Bore Dia. | Page |
|---|---|---|
| Open Type, Shielded Type, Sealed Type | 10 – 240 mm | B 020 |
| Open Type | 260 – 800 mm | B 040 |

CREEP-FREE BEARINGS

| | Bore Dia. | Page |
|---|---|---|
| | 10 – 100 mm | B 046 |

| | Bore Dia. | Page |
|---|---|---|
| Double Row | 10 - 90 mm | B 048 |

MAXIMUM TYPE BALL BEARINGS

| | Bore Dia. | Page |
|---|---|---|
| | 25 – 110 mm | B 050 |

MAGNETO BEARINGS

| | Bore Dia. | Page |
|---|---|---|
| | 4 – 20 mm | B 052 |

## DESIGN, TYPES, AND FEATURES

### SINGLE-ROW DEEP GROOVE BALL BEARINGS

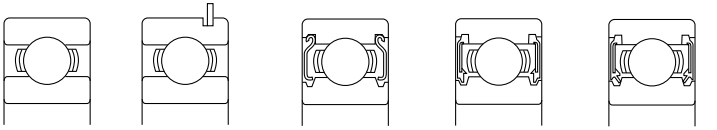
Single-Row Deep Groove Ball Bearings are classified into the types shown below.

The proper amount of good quality grease is packed in shielded and sealed ball bearings. A comparison of the features of each type is shown in Table 1.

### Table 1 Features of Sealed Ball Bearings

| Type | Shielded Type (ZZ Type) | Non-Contact Rubber Sealed Type (VV Type) | Contact Rubber Sealed Type (DDU Type) |
|---|---|---|---|
| **Torque** | Low | Low | Higher than ZZ, VV types due to contact seal |
| **Speed capability** | Good | Good | Limited by contact seals |
| **Grease sealing effectiveness** | Good | Better than ZZ type | A little better than VV type |
| **Dust resistance** | Good | Better than ZZ type (usable in moderately dusty environment) | Best (usable even in very dusty environment) |
| **Water resistance** | Not suitable | Not suitable | Good (usable even if fluid is splashed on bearing) |
| **Operating temperature (1)** | −10 to +110°C | −10 to +110°C | −10 to +100°C |

**Note** (1) The above temperature range applies to standard bearings. By using cold or heat resistant grease and changing the type of rubber, the operating temperature range can be extended. For such applications, please contact NSK.



Open Type | With Snap Ring | Shielded Type (ZZ Type) | Non-Contact Rubber Sealed Type (VV Type) | Contact Rubber Sealed Type (DDU Type)

For deep groove ball bearings, pressed cages are usually used. For big bearings, machined brass cages are used. (Refer to Table 2). Machined cages are also used for high speed applications.

### Table 2 Standard Cages for Deep Groove Ball Bearings

| Series | Pressed Steel Cages | Machined Brass Cages |
|---|---|---|
| **68** | 6800 – 6838 | 6840 – 68/800 |
| **69** | 6900 – 6936 | 6938 – 69/800 |
| **160** | 16001 – 16026 | 16028 – 16064 |
| **60** | 6000 – 6040 | 6044 – 60/670 |
| **62** | 6200 – 6240 | 6244 – 6272 |
| **63** | 6300 – 6332 | 6334 – 6356 |

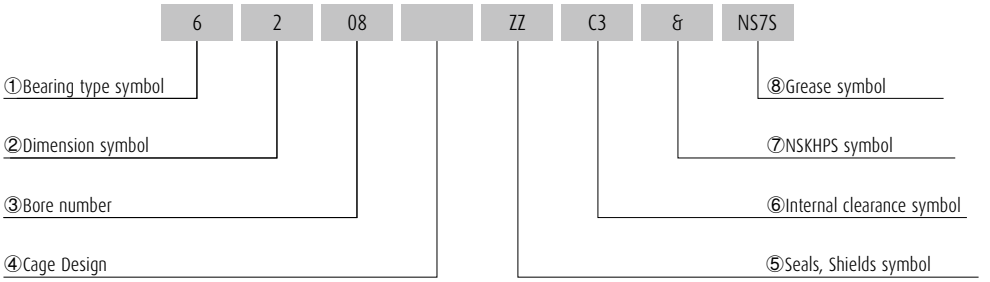
### Table 3 Standard Cages for Double Row Deep Grove Ball Bearings

| Series | Polyamid Cages |
|---|---|
| **42xxB** | 4200B - 4218B |
| **43xxB** | 4302B - 4315B |

## ☐ Formulation of Bearing Numbers

Single-Row Deep Groove Ball Bearings

Bearing number example:

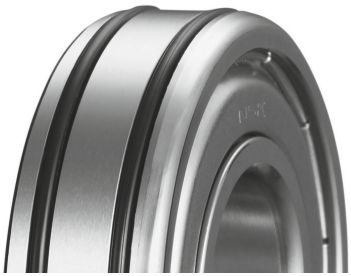



| | |
|---|---|
| ①Bearing type symbol | 6 : Single-Row Deep Groove Ball Bearings : 4 Double Row Deep Groove Ball Bearing |
| ②Dimension symbol | 2 : 02 Series, 3 : 03 Series, 9 : 19 Series, 0 : 10 Series |
| ③Bore number | Less than 03, Bearing bore 00 : 10mm, 01 : 12mm, 02 : 15mm, 03 : 17mm<br>Over 04, Bearing bore Bore number X 5 (mm) |
| ④Cage Design | Blanck: Steel, T/T1X: Plastic, M: Brass |
| ⑤Seals, Shields symbol | ZZ : Shield on Both Side , DDU : Contact Rubber Seal on Both Side, VV: Non-Contact Rubber Sealed on Both Side |
| ⑥Internal clearance symbol | Omitted : CN clearance*1, C3 : Clearance greater than CN, C4 : Clearance greater than C3, CM : For Electric Motors*1 |
| ⑦NSKHPS symbol | & : NSKHPS Bearings |
| ⑧Grease symbol | NS7 : NS HI-LUBE |

*1 The CM clearance can be used in substitute of the CN clearance. (The opposite is not available.)

## Creep-Free Bearings

Creep-Free Bearings, which come with two O-rings mounted in the outer ring, help to prevent the occurrence of creep by restricting the amount of clearance between the outer ring and housing.
No special machining is required; bearings can be used with the same housing as standard bearings.
In creep limit load tests, the more housing clearance is reduced, the greater the improvement in creep prevention, due to the tension of the O-ring mounted in the outer ring.



### Features

› **Prevents creep**

O-rings help prevent creep.

› **Reusable housing**

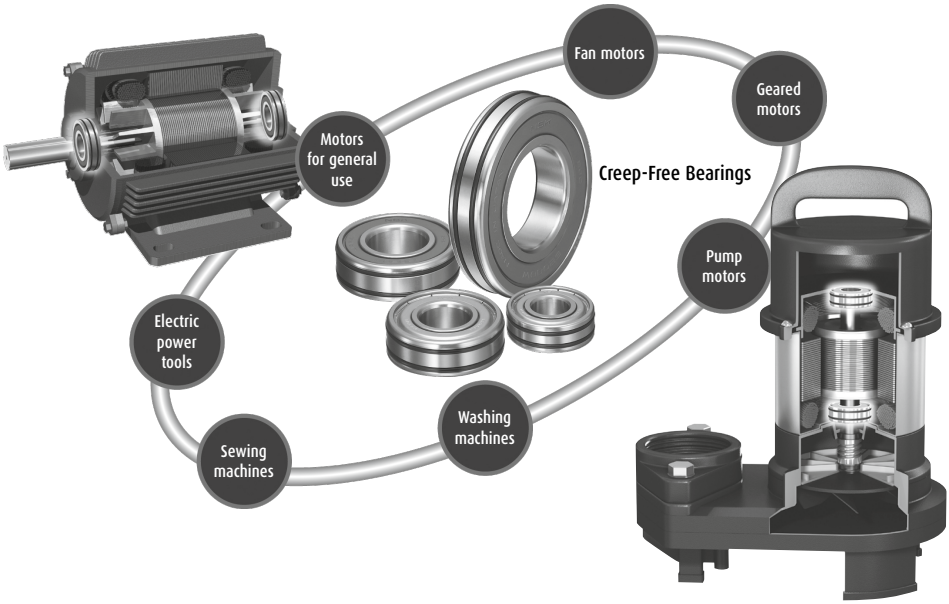
Very little abrasion occurs on the bore surface of the housing, making reuse possible.

› **Easy to assemble**

Assembly is easy since bearings can be fitted with a loose tolerance.

› **No special machining of the housing is required**

Bearings can be replaced since boundary dimensions are identical to standard bearings. No reworking of the housing is required.



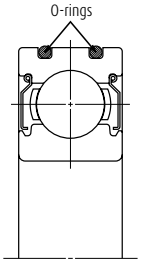



Fig. 1 Structure of Creep-Free Bearings

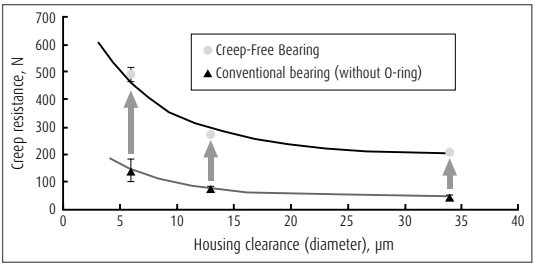



Fig. 2 Creep limit load test (example: 6204)

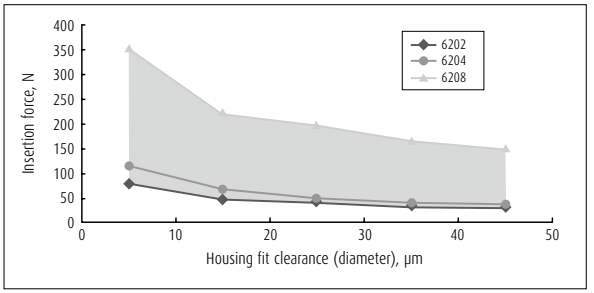



Fig. 3 Fit and insertion force

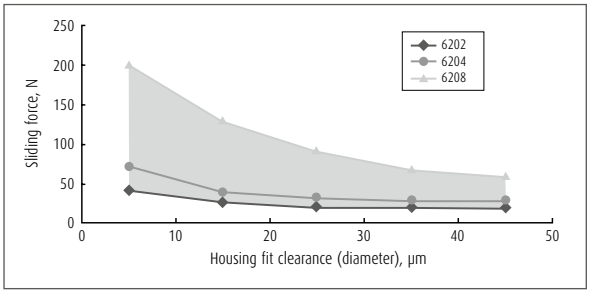



Fig. 4 Fit and sliding force

**Note on mounting Creep-Free Bearings**

› When oil or grease is applied to the outer diameter of the bearing, use a mineral oil or a synthetic hydrocarbon oil (NSK's EA2, etc.).

› O-ring material is nitrile rubber (operating temperature range: −30 to 120°C) as a standard specification. Please contact NSK for use under special environments such as high temperatures.

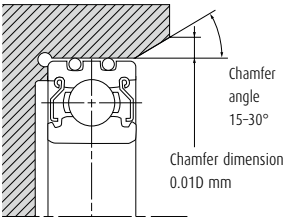
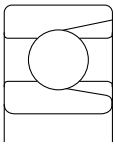



Fig. 5 Housing shape and dimension

Note on the product name "Creep-Free Bearings": The term "free" should not be construed to mean that creep is nonexistent.



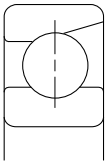
## MAXIMUM TYPE BALL BEARINGS

Maximum Type Ball Bearings contain a larger number of balls than normal deep groove ball bearings because of filling slots in the inner and outer rings. Because of their filling slots, they are not suitable for applications with high axial loads.

BL2 and BL3 types of bearings have boundary dimensions equal to those of single-row deep groove ball bearings of Series 62 and 63 respectively. Besides the open type, ZZ type shielded bearings are also available.

When using these bearings, it is important for the filling slot in the outer ring to be outside of the loaded zone as much as possible.

Their cages are pressed steel.



## MAGNETO BEARINGS

The groove in the inner ring is a little shallower than that of deep groove ball bearings and one side of the outer ring is relieved. Consequently, the outer ring is separable, which makes it convenient for mounting.

Pressed cages are standard, but for high speed applications, machined synthetic resin cages are used.

## PRECAUTIONS FOR USE OF DEEP GROOVE BALL BEARINGS

For deep groove ball bearings, if the bearing load is too small during operation, slippage occurs between the balls and raceways, which may result in smearing. The higher the weight of balls and cage, the higher this tendency becomes, especially for large bearings. If very small bearing loads are expected, please contact NSK for selection of an appropriate bearing.

## TOLERANCES AND RUNNING ACCURACY


| | Table | Pages |
|---|---|---|
| Single-Row Deep Groove Ball Bearings | 7.2 | A128 to A131 |
| Maximum Type Ball Bearings | 7.2 | A128 to A131 |
| Magneto Bearings | 7.5 | A138 and A139 |


## RECOMMENDED FITS


| | Table | Page |
|---|---|---|
| Single-Row Deep Groove Ball Bearings | 8.3 | A164 |
| | 8.5 | A165 |
| Maximum Type Ball Bearings | 8.3 | A164 |
| | 8.5 | A165 |
| Magneto Bearings | 8.3 | A164 |
| | 8.5 | A165 |


## INTERNAL CLEARANCE


| | Table | Page |
|---|---|---|
| Single-Row Deep Groove Ball Bearings | 8.10 | A169 |
| Maximum Type Ball Bearings | 8.11 | A169 |
| Magneto Bearings | 8.12 | A169 |


## LIMITING SPEEDS (GREASE/OIL)

The limiting speeds (grease) and limiting speeds (oil) listed in the bearing tables should be adjusted depending on the bearing load condition. Also, higher speeds are attainable by making changes in the lubrication method, cage design, etc. Refer to page A098 for detailed information.

## TECHNICAL DATA
## Radial and Axial Internal Clearances and Contact Angles for Single Row Deep Groove Ball Bearings
### (1) Radial and Axial Internal Clearances

The internal clearance in single row bearings has been specified as the radial internal clearance. The bearing internal clearance is the amount of relative displacement possible between the bearing rings when one ring is fixed and the other ring does not bear a load. The amount of movement along the direction of the bearing radius is called the radial clearance, and the amount along the direction of the axis is called the axial clearance.

The geometric relation between the radial and axial clearance is shown in Fig. 1.

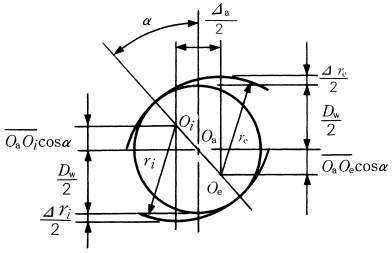



Fig. 1 Relationship Between $\Delta_r$ and $\Delta_a$

Symbols used in Fig. 1

| | |
|---|---|
| $O_a$: | Ball center |
| $O_e$: | Center of groove curvature, outer ring |
| $O_i$: | Center of groove curvature, inner ring |
| $D_w$: | Ball diameter (mm) |
| $r_e$: | Radius of outer ring groove (mm) |
| $r_i$: | Radius of inner ring groove (mm) |
| a: | Contact angle (°) |
| $\Delta_r$: | Radial clearance (mm) |
| $\Delta_a$: | Axial clearance (mm) |

It is apparent from Fig. 1 that $\Delta_r=\Delta r_e+\Delta r_i$.

From geometric relationships, various equations for clearance, contact angle, etc. can be derived.

$$\Delta r=2\,(1-\cos a)\,(r_e+r_i-D_w) \quad \cdots\cdots (1)$$

$$\Delta a=2\sin a\,(r_e+r_i-D_w) \quad \cdots\cdots (2)$$

$$\frac{\Delta_a}{\Delta_r}=\cot\frac{a}{2} \quad \cdots\cdots (3)$$

$$\Delta \fallingdotseq 2\,(r_e+r_i-D_w)^{1/2}\Delta r^{1/2} \quad \cdots\cdots (4)$$

$$a=\cos^{-1}\left(\frac{r_e+r_i-D_w-\frac{\Delta_r}{2}}{r_e+r_i-D_w}\right) \quad \cdots\cdots (5)$$

$$a=\sin^{-1}\left(\frac{\Delta_a/2}{r_e+r_i-D_w}\right) \quad \cdots\cdots (6)$$

Because $(r_e+r_i-D_w)$ is a constant, it is apparent why fixed relationships between $\Delta r$, $\Delta a$ and a exist for all the various bearing types.

As was previously mentioned, the clearances for deep groove ball bearings are given as radial clearances, but there are specific applications where it is desirable to have an axial clearance as well. The relationship between deep groove ball bearing radial clearance $\Delta r$ and axial clearance $\Delta a$ is given in Equation (4).
To simplify,

$$\Delta a \fallingdotseq K\,\Delta r^{1/2} \quad \cdots\cdots (7)$$

where K: Constant depending on bearing design

$$K=2\,(r_e+r_i-D_w)^{1/2}$$

Fig. 2 shows one example. The various values for K are presented by bearing size in Table 1 below.

**Example**

Assume a 6312 bearing, for a sample calculation, which has a radial clearance of 0.017 mm. From Table 1, K=2.09. Therefore, the axial clearance $\Delta a$ is:

$\Delta=2.09\times\sqrt{0.017}=2.09\times 0.13=0.27$ (mm)

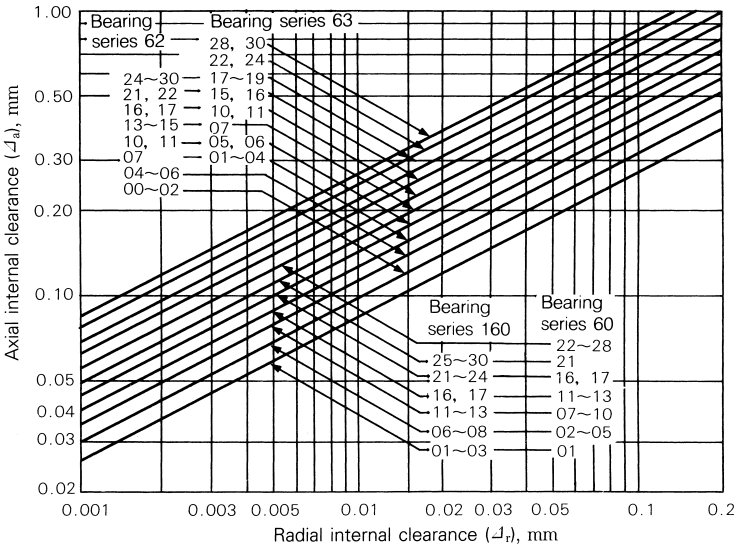



Fig. 2 Radial Clearance, $\Delta_r$ and Axial Clearance, $\Delta_a$ of Deep Groove Ball Bearings

## Table 1 Constant Values of K for Radial and Axial Clearance Conversion

| Bearing bore No. | K | | | |
|---|---|---|---|---|
| | Series 160 | Series 60 | Series 62 | Series 63 |
| 00 | – | – | 0.93 | 1.14 |
| 01 | 0.80 | 0.80 | 0.93 | 1.06 |
| 02 | 0.80 | 0.93 | 0.93 | 1.06 |
| 03 | 0.80 | 0.93 | 0.99 | 1.11 |
| 04 | 0.90 | 0.96 | 1.06 | 1.07 |
| 05 | 0.90 | 0.96 | 1.06 | 1.20 |
| 06 | 0.96 | 1.01 | 1.07 | 1.19 |
| 07 | 0.96 | 1.06 | 1.25 | 1.37 |
| 08 | 0.96 | 1.06 | 1.29 | 1.45 |
| 09 | 1.01 | 1.11 | 1.29 | 1.57 |
| 10 | 1.01 | 1.11 | 1.33 | 1.64 |
| 11 | 1.06 | 1.20 | 1.40 | 1.70 |
| 12 | 1.06 | 1.20 | 1.50 | 2.09 |
| 13 | 1.06 | 1.20 | 1.54 | 1.82 |
| 14 | 1.16 | 1.29 | 1.57 | 1.88 |
| 15 | 1.16 | 1.29 | 1.57 | 1.95 |
| 16 | 1.20 | 1.37 | 1.64 | 2.01 |
| 17 | 1.20 | 1.37 | 1.70 | 2.06 |
| 18 | 1.29 | 1.44 | 1.76 | 2.11 |
| 19 | 1.29 | 1.44 | 1.82 | 2.16 |
| 20 | 1.29 | 1.44 | 1.88 | 2.25 |
| 21 | 1.37 | 1.54 | 1.95 | 2.32 |
| 22 | 1.40 | 1.64 | 2.01 | 2.40 |
| 24 | 1.40 | 1.64 | 2.06 | 2.40 |
| 26 | 1.54 | 1.70 | 2.11 | 2.49 |
| 28 | 1.54 | 1.70 | 2.11 | 2.59 |
| 30 | 1.54 | 1.76 | 2.11 | 2.59 |

### (2) Relation between Radial Clearance and Contact Angle

Single-row deep groove ball bearings are sometimes used as thrust bearings. In such applications, it is recommended to make the contact angle as large as possible.

The contact angle for ball bearings is determined by the geometric relationship between the radial clearance and the radii of the inner and outer grooves. Using Equations (1) to (6), Fig. 3 shows the particular relationship between the radial clearance and contact angle of 62 and 63 series bearings. The initial contact angle, $a_0$, is the initial contact angle when the axial load is zero. Application of any load to the bearing will change this contact angle.

If the initial contact angle $a_0$ exceeds 20°, it is necessary to check whether or not the contact area of the ball and raceway touch the edge of raceway shoulder. (Refer to Section 8.1.2)

For applications when an axial load alone is applied, the radial clearance for deep groove ball bearings is normally greater than the normal clearance in order to ensure that the contact anlgle is relatively large. The initial contact angles for C3 and C4 clearances are given for selected bearing sizes in Table 2 below.

**Table 2 Initial Contact Angle, $a_0$, with C3 and C4 Clearances**

| Bearing No. | $a_0$ with C3 | $a_0$ with C4 |
|---|---|---|
| 6205 | 12.5° to 18° | 16.5° to 22° |
| 6210 | 11.5° to 16.5° | 13.5° to 19.5° |
| 6215 | 11.5° to 16° | 15.5° to 19.5° |
| 6220 | 10.5° to 14.5° | 14° to 17.5° |
| 6305 | 11° to 16° | 14.5° to 19.5° |
| 6310 | 9.5° to 13.5° | 12° to 16° |
| 6315 | 9.5° to 13.5° | 12.5° to 15.5° |
| 6320 | 9° to 12.5° | 12° to 15° |

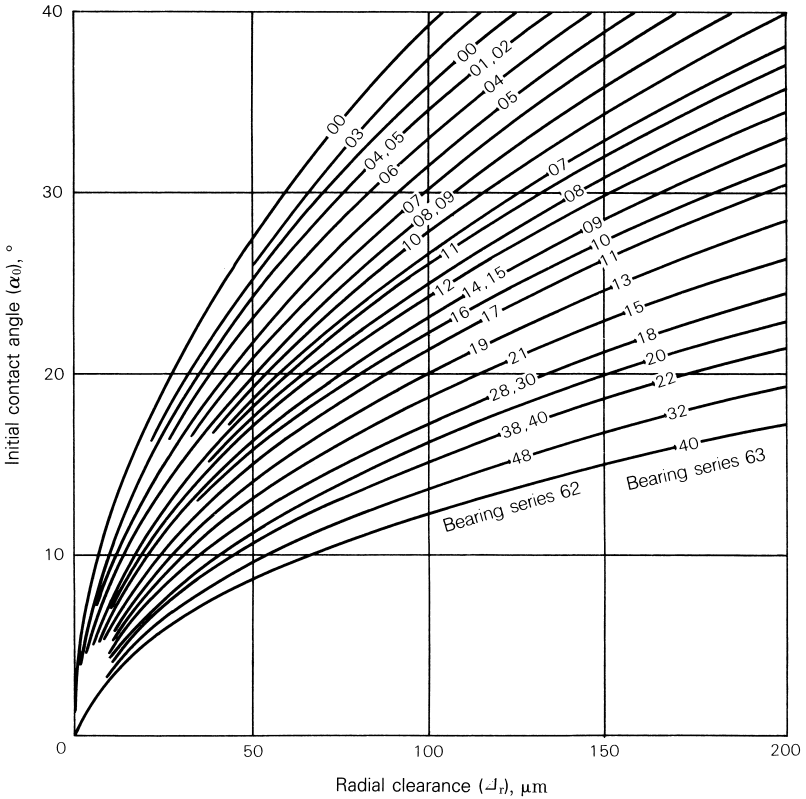



Fig. 3 Radial Clearance and Contact Angle

## Features and Operating Temperature Range of Ball Bearing Seal Material

The sealed ball bearing is a ball bearing with seals as shown in Figs. 1 and 2. There are two seal types: non-contact seal type and contact seal type. For rubber seal material, nitrile rubber is used for general purpose and poly-acrylic rubber, silicon rubber, and fluoric rubber are used depending on temperature conditions.

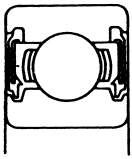
These rubbers have their own unique nature and appropriate rubber must be selected by considering the particular application environment and running conditions.

Table 1 shows principal features of each rubber material and the operating temperature range of the bearing seal. The operating temperature range of Table 1 is a guideline for continuous operation. Thermal aging of rubber is related to the temperature and time. Rubber may be used in a much wider range of operating temperatures depending on the operating time and frequency.

In the non-contact seal, heat generation due to friction on the lip can be ignored. And thermal factors, which cause aging of the rubber, are physical changes due to atmospheric and bearing temperatures. Accordingly, increased hardness or loss of elasticity due to thermal aging exerts only a negligible effect on the seal performance. A rubber non-contact seal can thus be used in an expanded range of operating temperatures greater than that for a contact seal.

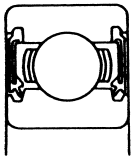
But there are some disadvantages. The contact seal has a problem with wear occurring at the seal lip due to friction, thermal plastic deformation, and hardening. When friction or plastic deformation occurs, the contact pressure between the lip and slide surface decreases, resulting in a clearance. This clearance is minimum and does not cause excessive degradation of sealing performance (for instance, it does not allow dust entry or grease leakage). In most cases, this minor plastic deformation or slightly increased hardness presents no practical problems.

However, in external environments with dust and water in large quantity, the bearing seal is used as an auxiliary seal and a principal seal should be provided separately. As so far described, the operating temperature range of rubber material is only a guideline for selection. Since heat resistant rubber is expensive, it is important to understand the temperature conditions so that an economical selection can be made. Due attention should also be paid not only to heat resistance, but also to the distinctive features of each rubber.



Non-contact rubber seal (VV)

Fig. 1



Contact rubber seal (DDU)

Fig. 2

## Table 1 Features and Operating Temperature Range of Rubber Materials

| Material | | Nitrile rubber | Polyacrylic rubber | Silicon rubber | Fluorine rubber |
|---|---|---|---|---|---|
| Key features | | ○Most popular seal material<br>○Superior in oil and wear resistances and mechanical properties<br>○Readily ages under direct sunrays<br>○Less expensive than other rubbers | ○Superior in heat and oil resistances<br>○Large compression causes permanent deformation<br>○Inferior in cold resistance<br>○One of the less expensive materials among the high temperature materials<br>○Attention is necessary because it swells the ester oil based grease | ○High heat and cold resistances<br>○Inferior in mechanical properties other than permanent deformation by compression. Pay attention to tear strength<br>○Pay attention so as to avoid swell caused by low aniline point mineral oil, silicone grease, and silicone oil | ○High heat resistance<br>○Superior in oil and chemical resistances<br>○Cold resistance similar to nitrile rubber<br>○Attention is necessary because it deteriorates the urea grease |
| Operating temperature range (1) (°C) | Non-contact seal | −50 to +130 | −30 to +170 | −100 to +250 | −50 to +220 |
| | Contact seal | −30 to +110 | −15 to +150 | −70 to +200 | −30 to +200 |

**Note** (1) This operating temperature is the temperature of seal rubber materials.

**Notes** (4) Snap ring groove dimensions and snap ring dimensions are not conformed to ISO15.

**Remarks** 1. Diameter Series 7 (extra thin section bearings) are also available, please contact NSK.
2. When using bearings with rotating outer rings, contact NSK if they are sealed, shielded, or have snap rings.

## Free Space and Grease Filling Amount for Deep Groove Ball Bearings

Grease lubrication can simplify the bearing's peripheral construction. In place of oil lubrication, grease lubrication is now employed along with enhancement of the grease quality for applications in many fields. It is important to select a grease appropriate to the operating conditions. Due care is also necessary as to the filling amount, since too much or too little grease greatly affects the temperature rise and torque. The amount of grease needed depends on such factors as housing construction, free space, grease brand, and environment. A general guideline is described next.

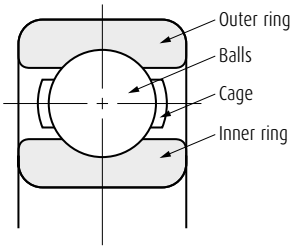
First, the bearing is filled with an appropriate amount of grease. In this case, it is essential to push grease onto the cage guide surface. Then, the free space, whic excludes the spindle and bearing inside the housing, is filled with an amount of grease as shown next:

1/2 to 2/3..... when the bearing speed is 50% or less of the allowable speed specified in the catalog.

1/3 to 1/2..... when the bearing speed is 50% or more.

Roughly, low speeds require more grease while high speeds require less grease. Depending on the particular application, the filling amount may have to be reduced further to reduce the torque and to prevent heat generation. When the bearing speed is extremely low, on the other hand, grease may be packed almost full to prevent dust and water entry. Accordingly, it is necessary to know the extent of the housing's free space for the specific bearing to determine the correct filling amount. As a reference, the volume of free space is shown in Table 1 for an open type deep groove ball bearing.

Note that the free space of the open type deep groove ball bearing is the volume obtained by subtracting the volume of the balls and cage from the space formed between inner and outer rings.



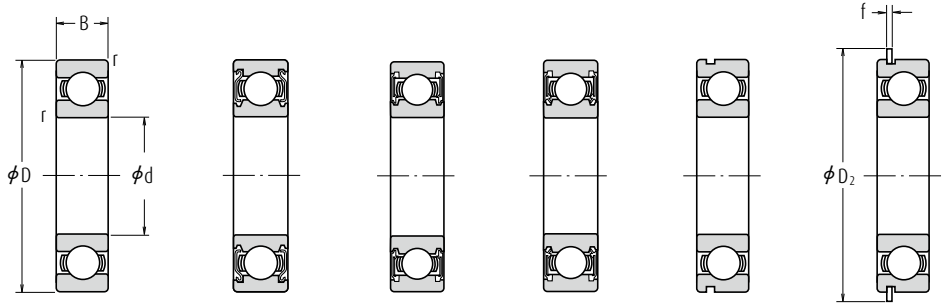
## Table 1 Free Space of Open Type Deep Groove Ball Bearing

Units : $cm^3$

| Bearing bore No. | Bearing free space | | | Bearing bore No. | Bearing free space | | |
|---|---|---|---|---|---|---|---|
| | Bearing series | | | | Bearing series | | |
| | 60 | 62 | 63 | | 60 | 62 | 63 |
| 00 | 1.2 | 1.5 | 2.9 | 14 | 34 | 61 | 148 |
| 01 | 1.2 | 2.1 | 3.5 | 15 | 35 | 67 | 180 |
| 02 | 1.6 | 2.7 | 4.8 | 16 | 47 | 84 | 213 |
| 03 | 2.0 | 3.7 | 6.4 | 17 | 48 | 104 | 253 |
| 04 | 4.0 | 6.0 | 7.9 | 18 | 63 | 127 | 297 |
| 05 | 4.6 | 7.7 | 12 | 19 | 66 | 155 | 345 |
| 06 | 6.5 | 11 | 19 | 20 | 68 | 184 | 425 |
| 07 | 9.2 | 15 | 25 | 21 | 88 | 216 | 475 |
| 08 | 11 | 20 | 35 | 22 | 114 | 224 | 555 |
| 09 | 14 | 23 | 49 | 24 | 122 | 310 | 675 |
| 10 | 15 | 28 | 64 | 26 | 172 | 355 | 830 |
| 11 | 22 | 34 | 79 | 28 | 180 | 415 | 1 030 |
| 12 | 23 | 45 | 98 | 30 | 220 | 485 | 1 140 |
| 13 | 24 | 54 | 122 | 32 | 285 | 545 | 1 410 |

**Remark** The table above shows the free space of a bearing using a pressed steel cage. The free space of a bearing using a high-tension brass machined cage is about 50 to 60% of the value in the table.

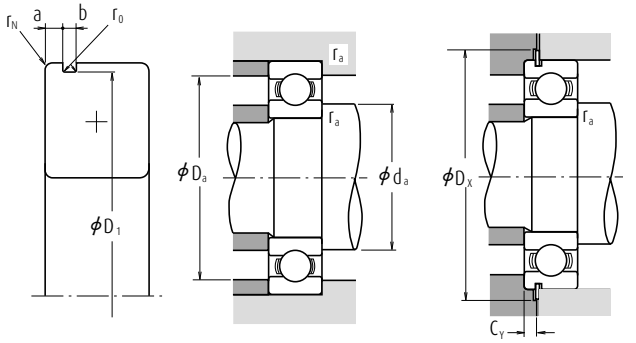
## Bore Diameter 10 – 17 mm




Open Type | Shielded Type ZZ | Non-Contact Sealed Type VV | Contact Sealed Type DD · DDU | With Snap Ring Groove N | With Snap Ring NR

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Factor | Limiting Speeds (min⁻¹) | | | Bearing Numbers | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Grease | | Oil | | | | |
| d | D | B | r min. | $C_r$ | $C_{or}$ | $f_o$ | Open Z · ZZ V · VV | DU DDU | Open Z | Open | Shielded | Sealed | |
| **10** | 19 | 5 | 0.3 | 1 720 | 840 | 14.8 | 34 000 | 24 000 | 40 000 | **6800** | **ZZ** | **VV** | **DD** |
| | 22 | 6 | 0.3 | 2 700 | 1 270 | 14.0 | 32 000 | 22 000 | 38 000 | **6900** | **ZZ** | **VV** | **DD** |
| | 26 | 8 | 0.3 | 4 550 | 1 970 | 12.4 | 30 000 | 22 000 | 36 000 | **6000** | **ZZ** | **VV** | **DDU** |
| | 30 | 9 | 0.6 | 5 100 | 2 390 | 13.2 | 24 000 | 18 000 | 30 000 | **6200** | **ZZ** | **VV** | **DDU** |
| | 30 | 9 | 0.6 | 5 350 | 2 390 | 13.2 | 28 000 | 18 000 | 34 000 | **6200*** | **ZZ** | **VV** | **DDU** |
| | 35 | 11 | 0.6 | 8 100 | 3 450 | 11.2 | 22 000 | 17 000 | 26 000 | **6300** | **ZZ** | **VV** | **DDU** |
| | 35 | 11 | 0.6 | 8 500 | 3 450 | 11.2 | 26 000 | 17 000 | 30 000 | **6300*** | **ZZ** | **VV** | **DDU** |
| **12** | 21 | 5 | 0.3 | 1 920 | 1 040 | 15.3 | 32 000 | 20 000 | 38 000 | **6801** | **ZZ** | **VV** | **DD** |
| | 24 | 6 | 0.3 | 2 890 | 1 460 | 14.5 | 30 000 | 20 000 | 36 000 | **6901** | **ZZ** | **VV** | **DD** |
| | 28 | 7 | 0.3 | 5 100 | 2 370 | 13.0 | 28 000 | — | 32 000 | **16001** | — | — | — |
| | 28 | 8 | 0.3 | 5 100 | 2 370 | 13.0 | 28 000 | 18 000 | 32 000 | **6001** | **ZZ** | **VV** | **DDU** |
| | 28 | 8 | 0.3 | 5 350 | 2 370 | 13.0 | 32 000 | 18 000 | 38 000 | **6001*** | **ZZ** | **VV** | **DDU** |
| | 32 | 10 | 0.6 | 6 800 | 3 050 | 12.3 | 22 000 | 17 000 | 28 000 | **6201** | **ZZ** | **VV** | **DDU** |
| | 32 | 10 | 0.6 | 7 150 | 3 050 | 12.3 | 26 000 | 17 000 | 32 000 | **6201*** | **ZZ** | **VV** | **DDU** |
| | 37 | 12 | 1 | 9 700 | 4 200 | 11.1 | 20 000 | 16 000 | 24 000 | **6301** | **ZZ** | **VV** | **DDU** |
| | 37 | 12 | 1.0 | 10 200 | 4 200 | 11.1 | 24 000 | 16 000 | 28 000 | **6301*** | **ZZ** | **VV** | **DDU** |
| **15** | 24 | 5 | 0.3 | 2 070 | 1 260 | 15.8 | 28 000 | 17 000 | 34 000 | **6802** | **ZZ** | **VV** | **DD** |
| | 28 | 7 | 0.3 | 4 350 | 2 260 | 14.3 | 26 000 | 17 000 | 30 000 | **6902** | **ZZ** | **VV** | **DD** |
| | 32 | 8 | 0.3 | 5 600 | 2 830 | 13.9 | 24 000 | — | 28 000 | **16002** | — | — | — |
| | 32 | 9 | 0.3 | 5 600 | 2 830 | 13.9 | 24 000 | 15 000 | 28 000 | **6002** | **ZZ** | **VV** | **DDU** |
| | 32 | 9 | 0.3 | 5 850 | 2 830 | 13.9 | 26 000 | 15 000 | 32 000 | **6002*** | **ZZ** | **VV** | **DDU** |
| | 35 | 11 | 0.6 | 7 650 | 3 750 | 13.2 | 20 000 | 14 000 | 24 000 | **6202** | **ZZ** | **VV** | **DDU** |
| | 35 | 11 | 0.6 | 8 000 | 3 750 | 13.2 | 22 000 | 14 000 | 28 000 | **6202*** | **ZZ** | **VV** | **DDU** |
| | 42 | 13 | 1 | 11 400 | 5 450 | 12.3 | 17 000 | 13 000 | 20 000 | **6302** | **ZZ** | **VV** | **DDU** |
| | 42 | 13 | 1.0 | 12 000 | 5 450 | 12.3 | 19 000 | 13 000 | 24 000 | **6302*** | **ZZ** | **VV** | **DDU** |
| **17** | 26 | 5 | 0.3 | 2 630 | 1 570 | 15.7 | 26 000 | 15 000 | 30 000 | **6803** | **ZZ** | **VV** | **DD** |
| | 30 | 7 | 0.3 | 4 600 | 2 550 | 14.7 | 24 000 | 15 000 | 28 000 | **6903** | **ZZ** | **VV** | **DDU** |
| | 35 | 8 | 0.3 | 6 000 | 3 250 | 14.4 | 22 000 | — | 26 000 | **16003** | — | — | — |
| | 35 | 10 | 0.3 | 6 000 | 3 250 | 14.4 | 22 000 | 13 000 | 26 000 | **6003** | **ZZ** | **VV** | **DDU** |
| | 35 | 10 | 0.3 | 6 300 | 3 250 | 14.4 | 24 000 | 13 000 | 28 000 | **6003*** | **ZZ** | **VV** | **DDU** |
| | 40 | 12 | 0.6 | 9 550 | 4 800 | 13.2 | 17 000 | 12 000 | 20 000 | **6203** | **ZZ** | **VV** | **DDU** |
| | 40 | 12 | 0.6 | 10 100 | 4 800 | 13.2 | 20 000 | 12 000 | 24 000 | **6203*** | **ZZ** | **VV** | **DDU** |
| | 47 | 14 | 1 | 13 600 | 6 650 | 12.4 | 15 000 | 11 000 | 18 000 | **6303** | **ZZ** | **VV** | **DDU** |
| | 47 | 14 | 1.0 | 14 300 | 6 650 | 12.4 | 17 000 | 11 000 | 20 000 | **6303*** | **ZZ** | **VV** | **DDU** |

**Notes** (1) For tolerances for the snap ring grooves and snap ring dimensions, refer to Pages **A116** to **A119**.
(2) When heavy axial loads are applied, increase $d_a$ and decrease $D_a$ from the above values.
(3) Ring types N and NR applicable only to open-type bearings. Please consult NSK about the snap ring groove dimensions of sealed or shielded bearings. (4) Snap ring groove dimensions and snap ring dimensions are not conformed to ISO15.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $\frac{f_0F_a}{C_{or}}$ | e | $\frac{F_a}{F_r}\leq e$ | | $\frac{F_a}{F_r}>e$ | |
|---|---|---|---|---|---|
| | | X | Y | X | Y |
| 0.172 | 0.19 | 1 | 0 | 0.56 | 2.30 |
| 0.345 | 0.22 | 1 | 0 | 0.56 | 1.99 |
| 0.689 | 0.26 | 1 | 0 | 0.56 | 1.71 |
| 1.03 | 0.28 | 1 | 0 | 0.56 | 1.55 |
| 1.38 | 0.30 | 1 | 0 | 0.56 | 1.45 |
| 2.07 | 0.34 | 1 | 0 | 0.56 | 1.31 |
| 3.45 | 0.38 | 1 | 0 | 0.56 | 1.15 |
| 5.17 | 0.42 | 1 | 0 | 0.56 | 1.04 |
| 6.89 | 0.44 | 1 | 0 | 0.56 | 1.00 |

## Static Equivalent Load

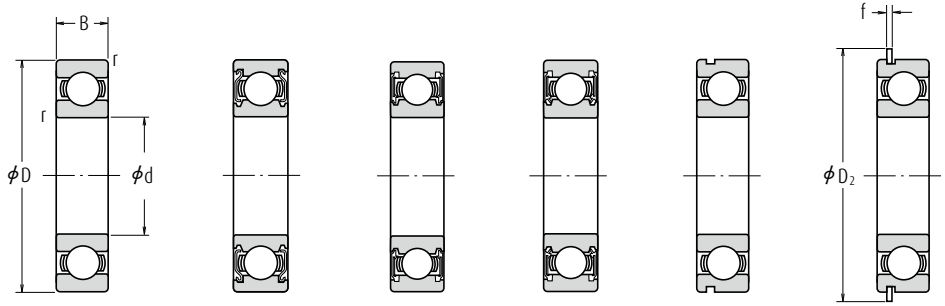
$\frac{F_a}{F_r}>0.8$, $P_0=0.6F_r+0.5F_a$

$\frac{F_a}{F_r}\leq 0.8$, $P_0=F_r$

| With Snap Ring Groove | With Snap Ring | Snap Ring Groove Dimensions (1) (mm) a max. | b min. | $D_1$ max. | $r_o$ max. | $r_N$ min. | Snap Ring (1) Dimensions (mm) $D_2$ max. | f max. | Abutment and Fillet Dimensions (mm) $d_a$(2) min. | $d_a$(2) max. | $D_a$(2) max. | $r_a$ max. | $D_x$ min. | $C_y$ max. | Mass (kg) approx. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| — | — | — | — | — | — | — | — | — | 12 | 12 | 17 | 0.3 | — | — | 0.005 |
| N(3) | NR(3) | 1.05 | 0.80 | 20.80 | 0.20 | 0.2 | 24.8 | 0.70 | 12 | 12.5 | 20 | 0.3 | 25.5 | 1.5 | 0.009 |
| N(4) | NR(4) | 1.35 | 0.87 | 24.50 | 0.20 | 0.3 | 28.7 | 0.84 | 12 | 13 | 24 | 0.3 | 29.4 | 1.9 | 0.018 |
| N | NR | 2.06 | 1.35 | 28.17 | 0.40 | 0.5 | 34.7 | 1.12 | 14 | 16 | 26 | 0.6 | 35.5 | 2.9 | 0.032 |
| — | — | — | — | — | — | — | — | — | 14 | 16 | 26 | 0.6 | — | — | 0.032 |
| N | NR | 2.06 | 1.35 | 33.17 | 0.40 | 0.5 | 39.7 | 1.12 | 14 | 16.5 | 31 | 0.6 | 40.5 | 2.9 | 0.052 |
| — | — | — | — | — | — | — | — | — | 14 | 16.5 | 31 | 0.6 | — | — | 0.052 |
| — | — | — | — | — | — | — | — | — | 14 | 14 | 19 | 0.3 | — | — | 0.006 |
| N(3) | NR(3) | 1.05 | 0.80 | 22.80 | 0.20 | 0.2 | 26.8 | 0.70 | 14 | 14.5 | 22 | 0.3 | 27.5 | 1.5 | 0.010 |
| — | — | — | — | — | — | — | — | — | 14 | — | 26 | 0.3 | — | — | 0.019 |
| N(4) | NR(4) | 1.35 | 0.87 | 26.50 | 0.20 | 0.3 | 30.7 | 0.84 | 14 | 15.5 | 26 | 0.3 | 31.4 | 1.9 | 0.022 |
| — | — | — | — | — | — | — | — | — | 14 | 15.5 | 26 | 0.3 | — | — | 0.022 |
| N | NR | 2.06 | 1.35 | 30.15 | 0.40 | 0.5 | 36.7 | 1.12 | 16 | 17 | 28 | 0.6 | 37.5 | 2.9 | 0.037 |
| — | — | — | — | — | — | — | — | — | 16 | 17 | 28 | 0.6 | — | — | 0.037 |
| N | NR | 2.06 | 1.35 | 34.77 | 0.40 | 0.5 | 41.3 | 1.12 | 17 | 18 | 32 | 1 | 42 | 2.9 | 0.060 |
| — | — | — | — | — | — | — | — | — | — | — | — | — | 42 | 2.9 | 0.060 |
| — | — | — | — | — | — | — | — | — | 17 | 17 | 22 | 0.3 | — | — | 0.007 |
| N(3) | NR(3) | 1.30 | 0.95 | 26.70 | 0.25 | 0.3 | 30.8 | 0.85 | 17 | 17 | 26 | 0.3 | 31.5 | 1.8 | 0.015 |
| — | — | — | — | — | — | — | — | — | 17 | — | 30 | 0.3 | — | — | 0.027 |
| N | NR | 2.06 | 1.35 | 30.15 | 0.40 | 0.3 | 36.7 | 1.12 | 17 | 19 | 30 | 0.3 | 37.5 | 2.9 | 0.031 |
| — | — | — | — | — | — | — | — | — | 17 | 19 | 30 | 0.3 | — | — | 0.031 |
| N | NR | 2.06 | 1.35 | 33.17 | 0.40 | 0.5 | 39.7 | 1.12 | 19 | 20.5 | 31 | 0.6 | 40.5 | 2.9 | 0.045 |
| — | — | — | — | — | — | — | — | — | 19 | 20.5 | 31 | 0.6 | — | — | 0.045 |
| N | NR | 2.06 | 1.35 | 39.75 | 0.40 | 0.5 | 46.3 | 1.12 | 20 | 22.5 | 37 | 1 | 47 | 2.9 | 0.083 |
| — | — | — | — | — | — | — | — | — | 20 | 22.5 | 37 | 1 | — | — | 0.083 |
| — | — | — | — | — | — | — | — | — | 19 | 19 | 24 | 0.3 | — | — | 0.007 |
| N(3) | NR(3) | 1.30 | 0.95 | 28.70 | 0.25 | 0.3 | 32.8 | 0.85 | 19 | 19.5 | 28 | 0.3 | 33.5 | 1.8 | 0.017 |
| — | — | — | — | — | — | — | — | — | 19 | — | 33 | 0.3 | — | — | 0.033 |
| N | NR | 2.06 | 1.35 | 33.17 | 0.40 | 0.3 | 39.7 | 1.12 | 19 | 21.5 | 33 | 0.3 | 40.5 | 2.9 | 0.041 |
| — | — | — | — | — | — | — | — | — | 19 | 21.5 | 33 | 0.3 | — | — | 0.041 |
| N | NR | 2.06 | 1.35 | 38.10 | 0.40 | 0.5 | 44.6 | 1.12 | 21 | 23.5 | 36 | 0.6 | 45.5 | 2.9 | 0.067 |
| — | — | — | — | — | — | — | — | — | 21 | 23.5 | 36 | 0.6 | — | — | 0.067 |
| N | NR | 2.46 | 1.35 | 44.60 | 0.40 | 0.5 | 52.7 | 1.12 | 22 | 25.5 | 42 | 1 | 53.5 | 3.3 | 0.113 |
| — | — | — | — | — | — | — | — | — | 22 | 25.5 | 42 | 1 | — | — | 0.113 |

**Remarks**
1. Diameter Series 7 (extra thin section bearings) are also available, please contact NSK.
2. When using bearings with rotating outer rings, contact NSK if they are sealed, shielded, or have snap rings.
3. The bearings denoted by an asterisk(*) are NSKHPS Deep groove ball bearings.

## Bore Diameter 20 – 30 mm




Open Type | Shielded Type ZZ | Non-Contact Sealed Type VV | Contact Sealed Type DD · DDU | With Snap Ring Groove N | With Snap Ring NR

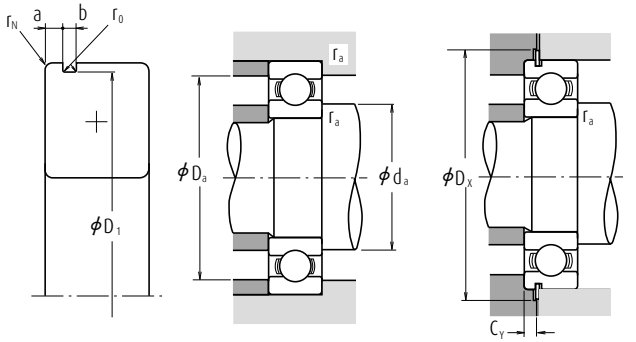
| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Factor | Limiting Speeds (min⁻¹) | | | Bearing Numbers | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Grease | | Oil | | | | |
| d | D | B | r min. | $C_r$ | $C_{or}$ | $f_o$ | Open Z · ZZ V · VV | DU DDU | Open Z | Open | Shielded | Sealed | |
| **20** | 32 | 7 | 0.3 | 4 000 | 2 470 | 15.5 | 22 000 | 13 000 | 26 000 | **6804** | **ZZ** | **VV** | **DD** |
| | 37 | 9 | 0.3 | 6 400 | 3 700 | 14.7 | 19 000 | 12 000 | 22 000 | **6904** | **ZZ** | **VV** | **DDU** |
| | 42 | 8 | 0.3 | 7 900 | 4 450 | 14.5 | 18 000 | – | 20 000 | **16004** | – | – | – |
| | 42 | 12 | 0.6 | 9 400 | 5 000 | 13.8 | 18 000 | 11 000 | 20 000 | **6004** | **ZZ** | **VV** | **DDU** |
| | 42 | 12 | 0.6 | 9 850 | 5 000 | 13.8 | 20 000 | 11 000 | 24 000 | **6004*** | **ZZ** | **VV** | **DDU** |
| | 47 | 14 | 1 | 12 800 | 6 600 | 13.1 | 15 000 | 11 000 | 18 000 | **6204** | **ZZ** | **VV** | **DDU** |
| | 47 | 14 | 1.0 | 13 400 | 6 600 | 13.1 | 17 000 | 11 000 | 20 000 | **6204*** | **ZZ** | **VV** | **DDU** |
| | 52 | 15 | 1.1 | 15 900 | 7 900 | 12.4 | 14 000 | 10 000 | 17 000 | **6304** | **ZZ** | **VV** | **DDU** |
| | 52 | 15 | 1.1 | 16 700 | 7 900 | 12.4 | 16 000 | 10 000 | 19 000 | **6304*** | **ZZ** | **VV** | **DDU** |
| **22** | 44 | 12 | 0.6 | 9 400 | 5 050 | 14.0 | 17 000 | 11 000 | 20 000 | **60/22** | **ZZ** | **VV** | **DDU** |
| | 50 | 14 | 1 | 12 900 | 6 800 | 13.5 | 14 000 | 9 500 | 16 000 | **62/22** | **ZZ** | **VV** | **DDU** |
| | 56 | 16 | 1.1 | 18 400 | 9 250 | 12.4 | 13 000 | 9 500 | 16 000 | **63/22** | **ZZ** | **VV** | **DDU** |
| **25** | 37 | 7 | 0.3 | 4 500 | 3 150 | 16.1 | 18 000 | 10 000 | 22 000 | **6805** | **ZZ** | **VV** | **DD** |
| | 42 | 9 | 0.3 | 7 050 | 4 550 | 15.4 | 16 000 | 10 000 | 19 000 | **6905** | **ZZ** | **VV** | **DDU** |
| | 47 | 8 | 0.3 | 8 850 | 5 600 | 15.1 | 15 000 | – | 18 000 | **16005** | – | – | – |
| | 47 | 12 | 0.6 | 10 100 | 5 850 | 14.5 | 15 000 | 9 500 | 18 000 | **6005** | **ZZ** | **VV** | **DDU** |
| | 47 | 12 | 0.6 | 10 600 | 5 850 | 14.5 | 18 000 | 9 500 | 22 000 | **6005*** | **ZZ** | **VV** | **DDU** |
| | 52 | 15 | 1 | 14 000 | 7 850 | 13.9 | 13 000 | 9 000 | 15 000 | **6205** | **ZZ** | **VV** | **DDU** |
| | 52 | 15 | 1.0 | 14 700 | 7 850 | 13.9 | 15 000 | 9 000 | 18 000 | **6205*** | **ZZ** | **VV** | **DDU** |
| | 62 | 17 | 1.1 | 20 600 | 11 200 | 13.2 | 11 000 | 8 000 | 13 000 | **6305** | **ZZ** | **VV** | **DDU** |
| | 62 | 17 | 1.1 | 21 600 | 11 200 | 13.2 | 13 000 | 8 000 | 16 000 | **6305*** | **ZZ** | **VV** | **DDU** |
| **28** | 52 | 12 | 0.6 | 12 500 | 7 400 | 14.5 | 14 000 | 8 500 | 16 000 | **60/28** | **ZZ** | **VV** | **DDU** |
| | 58 | 16 | 1 | 16 600 | 9 500 | 13.9 | 12 000 | 8 000 | 14 000 | **62/28** | **ZZ** | **VV** | **DDU** |
| | 68 | 18 | 1.1 | 26 700 | 14 000 | 12.4 | 10 000 | 7 500 | 13 000 | **63/28** | **ZZ** | **VV** | **DDU** |
| **30** | 42 | 7 | 0.3 | 4 700 | 3 650 | 16.4 | 15 000 | 9 000 | 18 000 | **6806** | **ZZ** | **VV** | **DD** |
| | 47 | 9 | 0.3 | 7 250 | 5 000 | 15.8 | 14 000 | 8 500 | 17 000 | **6906** | **ZZ** | **VV** | **DDU** |
| | 55 | 9 | 0.3 | 11 200 | 7 350 | 15.2 | 13 000 | – | 15 000 | **16006** | – | – | – |
| | 55 | 13 | 1 | 13 200 | 8 300 | 14.7 | 13 000 | 8 000 | 15 000 | **6006** | **ZZ** | **VV** | **DDU** |
| | 55 | 13 | 1.0 | 13 900 | 8 300 | 14.7 | 15 000 | 8 000 | 18 000 | **6006*** | **ZZ** | **VV** | **DDU** |
| | 62 | 16 | 1 | 19 500 | 11 300 | 13.8 | 11 000 | 7 500 | 13 000 | **6206** | **ZZ** | **VV** | **DDU** |
| | 62 | 16 | 1.0 | 20 400 | 11 300 | 13.8 | 12 000 | 7 500 | 15 000 | **6206*** | **ZZ** | **VV** | **DDU** |
| | 72 | 19 | 1.1 | 26 700 | 15 000 | 13.3 | 9 500 | 6 700 | 12 000 | **6306** | **ZZ** | **VV** | **DDU** |
| | 72 | 19 | 1.1 | 28 000 | 15 000 | 13.3 | 11 000 | 6 700 | 13 000 | **6306*** | **ZZ** | **VV** | **DDU** |

**Notes**

(1) For tolerances for the snap ring grooves and snap ring dimensions, refer to Pages **A116** to **A119.**

(2) When heavy axial loads are applied, increase $d_a$ and decrease $D_a$ from the above values.

(3) Ring types N and NR applicable only to open-type bearings. Please consult NSK about the snap ring groove dimensions of sealed or shielded bearings.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $\frac{f_oF_a}{C_{or}}$ | e | $\frac{F_a}{F_r}\leq e$ | | $\frac{F_a}{F_r}>e$ | |
|---|---|---|---|---|---|
| | | X | Y | X | Y |
| 0.172 | 0.19 | 1 | 0 | 0.56 | 2.30 |
| 0.345 | 0.22 | 1 | 0 | 0.56 | 1.99 |
| 0.689 | 0.26 | 1 | 0 | 0.56 | 1.71 |
| 1.03 | 0.28 | 1 | 0 | 0.56 | 1.55 |
| 1.38 | 0.30 | 1 | 0 | 0.56 | 1.45 |
| 2.07 | 0.34 | 1 | 0 | 0.56 | 1.31 |
| 3.45 | 0.38 | 1 | 0 | 0.56 | 1.15 |
| 5.17 | 0.42 | 1 | 0 | 0.56 | 1.04 |
| 6.89 | 0.44 | 1 | 0 | 0.56 | 1.00 |

## Static Equivalent Load

$\frac{F_a}{F_r}>0.8$, $P_0=0.6F_r+0.5F_a$

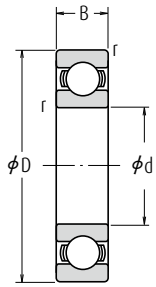
$\frac{F_a}{F_r}\leq 0.8$, $P_0=F_r$

| With Snap Ring Groove | With Snap Ring | Snap Ring Groove Dimensions (1) (mm) | | | | | Snap Ring (1) Dimensions (mm) | | Abutment and Fillet Dimensions (mm) | | | | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | a max. | b min. | $D_1$ max. | $r_o$ max. | $r_N$ min. | $D_2$ max. | f max. | $d_a$(2) min. | $d_a$(2) max. | $D_a$(2) max. | $r_a$ max. | $D_x$ min. | $C_y$ max. | approx. |
| N | NR | 1.30 | 0.95 | 30.70 | 0.25 | 0.3 | 34.8 | 0.85 | 22 | 22 | 30 | 0.3 | 35.5 | 1.8 | 0.017 |
| N | NR | 1.70 | 0.95 | 35.70 | 0.25 | 0.3 | 39.8 | 0.85 | 22 | 24 | 35 | 0.3 | 40.5 | 2.3 | 0.037 |
| — | — | — | — | — | — | — | — | — | 22 | — | 40 | 0.3 | — | — | 0.048 |
| N | NR | 2.06 | 1.35 | 39.75 | 0.40 | 0.5 | 46.3 | 1.12 | 24 | 25.5 | 38 | 0.6 | 47 | 2.9 | 0.068 |
| — | — | — | — | — | — | — | — | — | 24 | 25.5 | 38 | 0.6 | — | — | 0.068 |
| N | NR | 2.46 | 1.35 | 44.60 | 0.40 | 0.5 | 52.7 | 1.12 | 25 | 26.5 | 42 | 1 | 53.5 | 3.3 | 0.107 |
| — | — | — | — | — | — | — | — | — | 25 | 26.5 | 42 | 1 | — | — | 0.107 |
| N | NR | 2.46 | 1.35 | 49.73 | 0.40 | 0.5 | 57.9 | 1.12 | 26.5 | 28 | 45.5 | 1 | 58.5 | 3.3 | 0.145 |
| — | — | — | — | — | — | — | — | — | 26.5 | 28 | 45.5 | 1 | — | — | 0.145 |
| N | NR | 2.06 | 1.35 | 41.75 | 0.40 | 0.5 | 48.3 | 1.12 | 26 | 26.5 | 40 | 0.6 | 49 | 2.9 | 0.074 |
| N | NR | 2.46 | 1.35 | 47.60 | 0.40 | 0.5 | 55.7 | 1.12 | 27 | 29.5 | 45 | 1 | 56.5 | 3.3 | 0.119 |
| N | NR | 2.46 | 1.35 | 53.60 | 0.40 | 0.5 | 61.7 | 1.12 | 28.5 | 30.5 | 49.5 | 1 | 62.5 | 3.3 | 0.179 |
| N | NR | 1.30 | 0.95 | 35.70 | 0.25 | 0.3 | 39.8 | 0.85 | 27 | 27 | 35 | 0.3 | 40.5 | 1.8 | 0.021 |
| N(3) | NR(3) | 1.70 | 0.95 | 40.70 | 0.25 | 0.3 | 44.8 | 0.85 | 27 | 28.5 | 40 | 0.3 | 45.5 | 2.3 | 0.042 |
| — | — | — | — | — | — | — | — | — | 27 | — | 45 | 0.3 | — | — | 0.059 |
| N | NR | 2.06 | 1.35 | 44.60 | 0.40 | 0.5 | 52.7 | 1.12 | 29 | 30 | 43 | 0.6 | 53.5 | 2.9 | 0.079 |
| — | — | — | — | — | — | — | — | — | 29 | 30 | 43 | 0.6 | — | — | 0.079 |
| N | NR | 2.46 | 1.35 | 49.73 | 0.40 | 0.5 | 57.9 | 1.12 | 30 | 32 | 47 | 1 | 58.5 | 3.3 | 0.129 |
| — | — | — | — | — | — | — | — | — | 30 | 32 | 47 | 1 | — | — | 0.129 |
| N | NR | 3.28 | 1.90 | 59.61 | 0.60 | 0.5 | 67.7 | 1.70 | 31.5 | 36 | 55.5 | 1 | 68.5 | 4.6 | 0.235 |
| — | — | — | — | — | — | — | — | — | 31.5 | 36 | 55.5 | 1 | — | — | 0.235 |
| N | NR | 2.06 | 1.35 | 49.73 | 0.40 | 0.5 | 57.9 | 1.12 | 32 | 34 | 48 | 0.6 | 58.5 | 2.9 | 0.096 |
| N | NR | 2.46 | 1.35 | 55.60 | 0.40 | 0.5 | 63.7 | 1.12 | 33 | 35.5 | 53 | 1 | 64.5 | 3.3 | 0.175 |
| N | NR | 3.28 | 1.90 | 64.82 | 0.60 | 0.5 | 74.6 | 1.70 | 34.5 | 38 | 61.5 | 1 | 76 | 4.6 | 0.287 |
| N | NR | 1.30 | 0.95 | 40.70 | 0.25 | 0.3 | 44.8 | 0.85 | 32 | 32 | 40 | 0.3 | 45.5 | 1.8 | 0.024 |
| N | NR | 1.70 | 0.95 | 45.70 | 0.25 | 0.3 | 49.8 | 0.85 | 32 | 34 | 45 | 0.3 | 50.5 | 2.3 | 0.052 |
| — | — | — | — | — | — | — | — | — | 32 | — | 53 | 0.3 | — | — | 0.087 |
| N | NR | 2.08 | 1.35 | 52.60 | 0.40 | 0.5 | 60.7 | 1.12 | 35 | 36.5 | 50 | 1 | 61.5 | 2.9 | 0.116 |
| — | — | — | — | — | — | — | — | — | 35 | 36.5 | 50 | 1 | — | — | 0.116 |
| N | NR | 3.28 | 1.90 | 59.61 | 0.60 | 0.5 | 67.7 | 1.70 | 35 | 38.5 | 57 | 1 | 68.5 | 4.6 | 0.199 |
| — | — | — | — | — | — | — | — | — | 35 | 38.5 | 57 | 1 | — | — | 0.199 |
| N | NR | 3.28 | 1.90 | 68.81 | 0.60 | 0.5 | 78.6 | 1.70 | 36.5 | 42.5 | 65.5 | 1 | 80 | 4.6 | 0.345 |
| — | — | — | — | — | — | — | — | — | 36.5 | 42.5 | 65.5 | 1 | — | — | 0.345 |

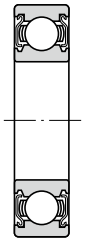
**Remarks**
1. Diameter Series 7 (extra thin section bearings) are also available, please contact NSK.
2. When using bearings with rotating outer rings, contact NSK if they are sealed, shielded, or have snap rings.
3. The bearings denoted by an asterisk(*) are NSKHPS Deep groove ball bearings.

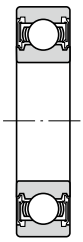
# Single-Row Deep Groove Ball Bearings

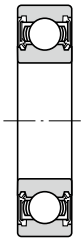
## Bore Diameter 32 – 45 mm

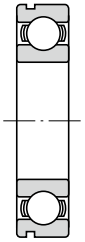


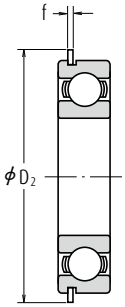
Open Type


Shielded Type
ZZ


Non-Contact
Sealed Type
VV


Contact
Sealed Type
DD · DDU

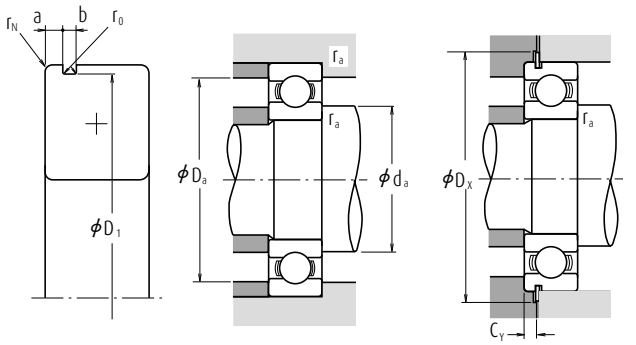

With Snap
Ring Groove
N



With
Snap Ring
NR

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Factor | Limiting Speeds (min⁻¹) | | | Bearing Numbers | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Grease | | Oil | | | | |
| d | D | B | r min. | $C_r$ | $C_{or}$ | $f_o$ | Open Z · ZZ V · VV | DU DDU | Open Z | Open | Shielded | Sealed | |
| **32** | 58 | 13 | 1 | 15 100 | 9 150 | 14.5 | 12 000 | 7 500 | 14 000 | **60/32** | **ZZ** | **VV** | **DDU** |
| | 65 | 17 | 1 | 20 700 | 11 600 | 13.6 | 10 000 | 7 100 | 12 000 | **62/32** | **ZZ** | **VV** | **DDU** |
| | 75 | 20 | 1.1 | 29 900 | 17 000 | 13.2 | 9 000 | 6 300 | 11 000 | **63/32** | **ZZ** | **VV** | **DDU** |
| **35** | 47 | 7 | 0.3 | 4 900 | 4 100 | 16.7 | 14 000 | 7 500 | 16 000 | **6807** | **ZZ** | **VV** | **DD** |
| | 55 | 10 | 0.6 | 10 600 | 7 250 | 15.5 | 12 000 | 7 500 | 15 000 | **6907** | **ZZ** | **VV** | **DDU** |
| | 62 | 9 | 0.3 | 11 700 | 8 200 | 15.6 | 11 000 | – | 13 000 | **16007** | – | – | – |
| | 62 | 14 | 1 | 16 000 | 10 300 | 14.8 | 11 000 | 6 700 | 13 000 | **6007** | **ZZ** | **VV** | **DDU** |
| | 62 | 14 | 1.0 | 16 800 | 10 300 | 14.8 | 13 000 | 6 700 | 15 000 | **6007*** | **ZZ** | **VV** | **DDU** |
| | 72 | 17 | 1.1 | 25 700 | 15 300 | 13.8 | 9 500 | 6 300 | 11 000 | **6207** | **ZZ** | **VV** | **DDU** |
| | 72 | 17 | 1.1 | 27 000 | 15 300 | 13.8 | 11 000 | 6 300 | 13 000 | **6207*** | **ZZ** | **VV** | **DDU** |
| | 80 | 21 | 1.5 | 33 500 | 19 200 | 13.2 | 8 500 | 6 000 | 10 000 | **6307** | **ZZ** | **VV** | **DDU** |
| | 80 | 21 | 1.5 | 35 000 | 19 200 | 13.2 | 10 000 | 6 000 | 12 000 | **6307*** | **ZZ** | **VV** | **DDU** |
| **40** | 52 | 7 | 0.3 | 6 350 | 5 550 | 17.0 | 12 000 | 6 700 | 14 000 | **6808** | **ZZ** | **VV** | **DD** |
| | 62 | 12 | 0.6 | 13 700 | 10 000 | 15.7 | 11 000 | 6 300 | 13 000 | **6908** | **ZZ** | **VV** | **DDU** |
| | 68 | 9 | 0.3 | 12 600 | 9 650 | 16.0 | 10 000 | – | 12 000 | **16008** | – | – | – |
| | 68 | 15 | 1 | 16 800 | 11 500 | 15.3 | 10 000 | 6 000 | 12 000 | **6008** | **ZZ** | **VV** | **DDU** |
| | 68 | 15 | 1.0 | 17 600 | 11 500 | 15.3 | 12 000 | 6 000 | 14 000 | **6008*** | **ZZ** | **VV** | **DDU** |
| | 80 | 18 | 1.1 | 29 100 | 17 900 | 14.0 | 8 500 | 5 600 | 10 000 | **6208** | **ZZ** | **VV** | **DDU** |
| | 80 | 18 | 1.1 | 30 500 | 17 900 | 14.0 | 9 500 | 5 600 | 12 000 | **6208*** | **ZZ** | **VV** | **DDU** |
| | 90 | 23 | 1.5 | 40 500 | 24 000 | 13.2 | 7 500 | 5 300 | 9 000 | **6308** | **ZZ** | **VV** | **DDU** |
| | 90 | 23 | 1.5 | 43 000 | 24 000 | 13.2 | 9 000 | 5 300 | 11 000 | **6308*** | **ZZ** | **VV** | **DDU** |
| **45** | 58 | 7 | 0.3 | 6 600 | 6 150 | 17.2 | 11 000 | 6 000 | 13 000 | **6809** | **ZZ** | **VV** | **DD** |
| | 68 | 12 | 0.6 | 14 100 | 10 900 | 15.9 | 9 500 | 5 600 | 12 000 | **6909** | **ZZ** | **VV** | **DDU** |
| | 75 | 10 | 0.6 | 14 900 | 11 400 | 15.9 | 9 000 | – | 11 000 | **16009** | – | – | – |
| | 75 | 16 | 1 | 20 900 | 15 200 | 15.3 | 9 000 | 5 300 | 11 000 | **6009** | **ZZ** | **VV** | **DDU** |
| | 75 | 16 | 1.0 | 22 000 | 15 200 | 15.3 | 10 000 | 5 300 | 12 000 | **6009*** | **ZZ** | **VV** | **DDU** |
| | 85 | 19 | 1.1 | 31 500 | 20 400 | 14.4 | 7 500 | 5 300 | 9 000 | **6209** | **ZZ** | **VV** | **DDU** |
| | 85 | 19 | 1.1 | 33 000 | 20 400 | 14.4 | 9 000 | 5 300 | 11 000 | **6209*** | **ZZ** | **VV** | **DDU** |
| | 100 | 25 | 1.5 | 53 000 | 32 000 | 13.1 | 6 700 | 4 800 | 8 000 | **6309** | **ZZ** | **VV** | **DDU** |
| | 100 | 25 | 1.5 | 55 500 | 32 000 | 13.1 | 7 500 | 4 800 | 9 500 | **6309*** | **ZZ** | **VV** | **DDU** |

**Notes**
(1) For tolerances for the snap ring grooves and snap ring dimensions, refer to Pages **A116** to **A119.**
(2) When heavy axial loads are applied, increase $d_a$ and decrease $D_a$ from the above values.
(3) Snap ring groove dimensions and snap ring dimensions are not conformed to ISO15.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $\frac{f_0F_a}{C_{or}}$ | e | $\frac{F_a}{F_r}\leq e$ | | $\frac{F_a}{F_r}>e$ | |
|---|---|---|---|---|---|
| | | X | Y | X | Y |
| 0.172 | 0.19 | 1 | 0 | 0.56 | 2.30 |
| 0.345 | 0.22 | 1 | 0 | 0.56 | 1.99 |
| 0.689 | 0.26 | 1 | 0 | 0.56 | 1.71 |
| 1.03 | 0.28 | 1 | 0 | 0.56 | 1.55 |
| 1.38 | 0.30 | 1 | 0 | 0.56 | 1.45 |
| 2.07 | 0.34 | 1 | 0 | 0.56 | 1.31 |
| 3.45 | 0.38 | 1 | 0 | 0.56 | 1.15 |
| 5.17 | 0.42 | 1 | 0 | 0.56 | 1.04 |
| 6.89 | 0.44 | 1 | 0 | 0.56 | 1.00 |

## Static Equivalent Load

$\frac{F_a}{F_r} > 0.8$, $P_0=0.6F_r+0.5F_a$

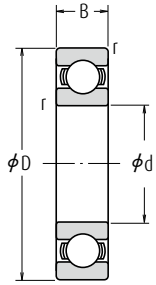
$\frac{F_a}{F_r} \leq 0.8$, $P_0=F_r$

| With Snap Ring Groove | With Snap Ring | Snap Ring Groove Dimensions (1) (mm) | | | | | Snap Ring (1) Dimensions (mm) | | Abutment and Fillet Dimensions (mm) | | | | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | a max. | b min. | $D_1$ max. | $r_0$ max. | $r_N$ min. | $D_2$ max. | f max. | $d_a$(2) min. | $d_a$(2) max. | $D_a$(2) max. | $r_a$ max. | $D_x$ min. | $C_y$ max. | approx. |
| N | NR | 2.08 | 1.35 | 55.60 | 0.40 | 0.5 | 63.7 | 1.12 | 37 | 38.5 | 53 | 1 | 64.5 | 2.9 | 0.122 |
| N | NR | 3.28 | 1.90 | 62.60 | 0.60 | 0.5 | 70.7 | 1.70 | 37 | 40 | 60 | 1 | 71.5 | 4.6 | 0.225 |
| N | NR | 3.28 | 1.90 | 71.83 | 0.60 | 0.5 | 81.6 | 1.70 | 38.5 | 44.5 | 68.5 | 1 | 83 | 4.6 | 0.389 |
| N | NR | 1.30 | 0.95 | 45.70 | 0.25 | 0.3 | 49.8 | 0.85 | 37 | 37 | 45 | 0.3 | 50.5 | 1.8 | 0.027 |
| N | NR | 1.70 | 0.95 | 53.70 | 0.25 | 0.5 | 57.8 | 0.85 | 39 | 39 | 51 | 0.6 | 58.5 | 2.3 | 0.075 |
| — | — | — | — | — | — | — | — | — | 37 | — | 60 | 0.3 | — | — | 0.107 |
| N | NR | 2.08 | 1.90 | 59.61 | 0.60 | 0.5 | 67.7 | 1.70 | 40 | 41.5 | 57 | 1 | 68.5 | 3.4 | 0.151 |
| N | — | — | — | — | — | — | — | — | 40 | 41.5 | 57 | 1 | — | — | 0.151 |
| N | NR | 3.28 | 1.90 | 68.81 | 0.60 | 0.5 | 78.6 | 1.70 | 41.5 | 44.5 | 65.5 | 1 | 80 | 4.6 | 0.284 |
| — | — | — | — | — | — | — | — | — | 41.5 | 44.5 | 65.5 | 1 | — | — | 0.284 |
| N | NR | 3.28 | 1.90 | 76.81 | 0.60 | 0.5 | 86.6 | 1.70 | 43 | 47 | 72 | 1.5 | 88 | 4.6 | 0.464 |
| — | — | — | — | — | — | — | — | — | 43 | 47 | 72 | 1.5 | — | — | 0.464 |
| N | NR | 1.30 | 0.95 | 50.70 | 0.25 | 0.3 | 54.8 | 0.85 | 42 | 42 | 50 | 0.3 | 55.5 | 1.8 | 0.031 |
| N | NR | 1.70 | 0.95 | 60.70 | 0.25 | 0.5 | 64.8 | 0.85 | 44 | 46 | 58 | 0.6 | 65.5 | 2.3 | 0.112 |
| — | — | — | — | — | — | — | — | — | 42 | — | 66 | 0.3 | — | — | 0.13 |
| N | NR | 2.49 | 1.90 | 64.82 | 0.60 | 0.5 | 74.6 | 1.70 | 45 | 47.5 | 63 | 1 | 76 | 3.8 | 0.19 |
| — | — | — | — | — | — | — | — | — | 45 | 47.5 | 63 | 1 | — | — | 0.19 |
| N | NR | 3.28 | 1.90 | 76.81 | 0.60 | 0.5 | 86.6 | 1.70 | 46.5 | 50.5 | 73.5 | 1 | 88 | 4.6 | 0.366 |
| — | — | — | — | — | — | — | — | — | 46.5 | 50.5 | 73.5 | 1 | — | — | 0.366 |
| N | NR | 3.28 | 2.70 | 86.79 | 0.60 | 0.5 | 96.5 | 2.46 | 48 | 53 | 82 | 1.5 | 98 | 5.4 | 0.636 |
| — | — | — | — | — | — | — | — | — | 48 | 53 | 82 | 1.5 | — | — | 0.636 |
| N | NR | 1.30 | 0.95 | 56.70 | 0.25 | 0.3 | 60.8 | 0.85 | 47 | 47.5 | 56 | 0.3 | 61.5 | 1.8 | 0.038 |
| N | NR | 1.70 | 0.95 | 66.70 | 0.25 | 0.3 | 70.8 | 0.85 | 49 | 50 | 64 | 0.6 | 72 | 2.3 | 0.126 |
| — | — | — | — | — | — | — | — | — | 49 | — | 71 | 0.6 | — | — | 0.167 |
| N | NR | 2.49 | 1.90 | 71.83 | 0.60 | 0.5 | 81.6 | 1.70 | 50 | 53.5 | 70 | 1 | 83 | 3.8 | 0.241 |
| — | — | — | — | — | — | — | — | — | 50 | 53.5 | 70 | 1 | — | — | 0.241 |
| N | NR | 3.28 | 1.90 | 81.81 | 0.60 | 0.5 | 91.6 | 1.70 | 51.5 | 55.5 | 78.5 | 1 | 93 | 4.6 | 0.42 |
| — | — | — | — | — | — | — | — | — | 51.5 | 55.5 | 78.5 | 1 | — | — | 0.42 |
| N | NR | 3.28 | 2.70 | 96.80 | 0.60 | 0.5 | 106.50 | 2.46 | 53 | 61.5 | 92 | 1.5 | 108 | 5.4 | 0.829 |
| — | — | — | — | — | — | — | — | — | 53 | 61.5 | 92 | 1.5 | — | — | 0.829 |

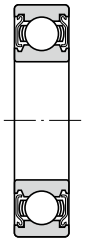
**Remarks**
1. Diameter Series 7 (extra thin section bearings) are also available, please contact NSK.
2. When using bearings with rotating outer rings, contact NSK if they are sealed, shielded, or have snap rings.
3. The bearings denoted by an asterisk(*) are NSKHPS Deep groove ball bearings.

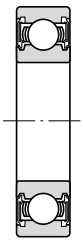
# Single-Row Deep Groove Ball Bearings

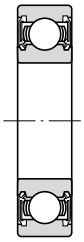
## Bore Diameter 50 – 60 mm

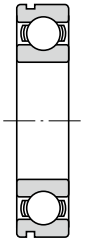


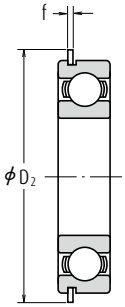
Open Type


Shielded Type
ZZ


Non-Contact
Sealed Type
VV


Contact
Sealed Type
DD · DDU

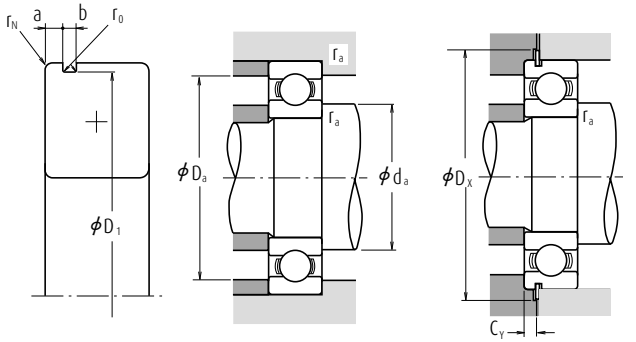

With Snap
Ring Groove
N



With
Snap Ring
NR

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Factor | Limiting Speeds (min⁻¹) | | | Bearing Numbers | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Grease | | Oil | | | | |
| d | D | B | r min. | $C_r$ | $C_{or}$ | $f_o$ | Open Z · ZZ V · VV | DU DDU | Open Z | Open | Shielded | Sealed | |
| **50** | 65 | 7 | 0.3 | 6 400 | 6 200 | 17.2 | 9 500 | 5 300 | 11 000 | **6810** | **ZZ** | **VV** | **DDU** |
| | 72 | 12 | 0.6 | 14 500 | 11 700 | 16.1 | 9 000 | 5 300 | 11 000 | **6910** | **ZZ** | **VV** | **DDU** |
| | 80 | 10 | 0.6 | 15 400 | 12 400 | 16.1 | 8 500 | – | 10 000 | **16010** | – | – | – |
| | 80 | 16 | 1 | 21 800 | 16 600 | 15.6 | 8 500 | 4 800 | 10 000 | **6010** | **ZZ** | **VV** | **DDU** |
| | 80 | 16 | 1.0 | 22 900 | 16 600 | 15.6 | 9 500 | 4 800 | 11 000 | **6010*** | **ZZ** | **VV** | **DDU** |
| | 90 | 20 | 1.1 | 35 000 | 23 200 | 14.4 | 7 100 | 4 800 | 8 500 | **6210** | **ZZ** | **VV** | **DDU** |
| | 90 | 20 | 1.1 | 37 000 | 23 200 | 14.4 | 8 500 | 4 800 | 10 000 | **6210*** | **ZZ** | **VV** | **DDU** |
| | 110 | 27 | 2 | 62 000 | 38 500 | 13.2 | 6 000 | 4 300 | 7 500 | **6310** | **ZZ** | **VV** | **DDU** |
| | 110 | 27 | 2.0 | 65 000 | 38 500 | 13.2 | 7 100 | 4 300 | 8 500 | **6310*** | **ZZ** | **VV** | **DDU** |
| **55** | 72 | 9 | 0.3 | 8 800 | 8 500 | 17.0 | 8 500 | 4 800 | 10 000 | **6811** | **ZZ** | **VV** | **DDU** |
| | 80 | 13 | 1 | 16 000 | 13 300 | 16.2 | 8 000 | 4 500 | 9 500 | **6911** | **ZZ** | **VV** | **DDU** |
| | 90 | 11 | 0.6 | 19 400 | 16 300 | 16.2 | 7 500 | – | 9 000 | **16011** | – | – | – |
| | 90 | 18 | 1.1 | 28 300 | 21 200 | 15.3 | 7 500 | 4 500 | 9 000 | **6011** | **ZZ** | **VV** | **DDU** |
| | 90 | 18 | 1.1 | 29 700 | 21 200 | 15.3 | 8 500 | 4 500 | 10 000 | **6011*** | **ZZ** | **VV** | **DDU** |
| | 100 | 21 | 1.5 | 43 500 | 29 300 | 14.3 | 6 300 | 4 300 | 7 500 | **6211** | **ZZ** | **VV** | **DDU** |
| | 100 | 21 | 1.5 | 45 500 | 29 300 | 14.3 | 7 500 | 4 300 | 9 000 | **6211*** | **ZZ** | **VV** | **DDU** |
| | 120 | 29 | 2 | 71 500 | 44 500 | 13.1 | 5 600 | 4 000 | 6 700 | **6311** | **ZZ** | **VV** | **DDU** |
| | 120 | 29 | 2.0 | 75 000 | 44 500 | 13.1 | 6 700 | 4 000 | 8 000 | **6311*** | **ZZ** | **VV** | **DDU** |
| **60** | 78 | 10 | 0.3 | 11 500 | 10 900 | 16.9 | 8 000 | 4 500 | 9 500 | **6812** | **ZZ** | **VV** | **DD** |
| | 85 | 13 | 1 | 19 400 | 16 300 | 16.2 | 7 500 | 4 300 | 9 000 | **6912** | **ZZ** | **VV** | **DDU** |
| | 95 | 11 | 0.6 | 20 000 | 17 500 | 16.3 | 7 100 | – | 8 500 | **16012** | – | – | – |
| | 95 | 18 | 1.1 | 29 500 | 23 200 | 15.6 | 7 100 | 4 000 | 8 500 | **6012** | **ZZ** | **VV** | **DDU** |
| | 95 | 18 | 1.1 | 31 000 | 23 200 | 15.6 | 8 000 | 4 000 | 9 500 | **6012*** | **ZZ** | **VV** | **DDU** |
| | 110 | 22 | 1.5 | 52 500 | 36 000 | 14.3 | 5 600 | 3 800 | 7 100 | **6212** | **ZZ** | **VV** | **DDU** |
| | 110 | 22 | 1.5 | 55 000 | 36 000 | 14.3 | 6 700 | 3 800 | 8 000 | **6212*** | **ZZ** | **VV** | **DDU** |
| | 130 | 31 | 2.1 | 82 000 | 52 000 | 13.1 | 5 300 | 3 600 | 6 300 | **6312** | **ZZ** | **VV** | **DDU** |
| | 130 | 31 | 2.1 | 86 000 | 52 000 | 13.1 | 6 000 | 3 600 | 7 100 | **6312*** | **ZZ** | **VV** | **DDU** |

**Notes** (1) For tolerances for the snap ring grooves and snap ring dimensions, refer to Pages **A116** to **A119.**
(2) When heavy axial loads are applied, increase $d_a$ and decrease $D_a$ from the above values.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $\frac{f_0F_a}{C_{or}}$ | e | $\frac{F_a}{F_r}\leq e$ | | $\frac{F_a}{F_r}>e$ | |
|---|---|---|---|---|---|
| | | X | Y | X | Y |
| 0.172 | 0.19 | 1 | 0 | 0.56 | 2.30 |
| 0.345 | 0.22 | 1 | 0 | 0.56 | 1.99 |
| 0.689 | 0.26 | 1 | 0 | 0.56 | 1.71 |
| 1.03 | 0.28 | 1 | 0 | 0.56 | 1.55 |
| 1.38 | 0.30 | 1 | 0 | 0.56 | 1.45 |
| 2.07 | 0.34 | 1 | 0 | 0.56 | 1.31 |
| 3.45 | 0.38 | 1 | 0 | 0.56 | 1.15 |
| 5.17 | 0.42 | 1 | 0 | 0.56 | 1.04 |
| 6.89 | 0.44 | 1 | 0 | 0.56 | 1.00 |

## Static Equivalent Load

$\frac{F_a}{F_r}>0.8$, $P_0=0.6F_r+0.5F_a$

$\frac{F_a}{F_r}\leq 0.8$, $P_0=F_r$

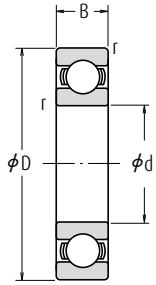
| With Snap Ring Groove | With Snap Ring | Snap Ring Groove Dimensions (1) (mm) | | | | | Snap Ring (1) Dimensions (mm) | | Abutment and Fillet Dimensions (mm) | | | | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | a max. | b min. | $D_1$ max. | $r_o$ max. | $r_N$ min. | $D_2$ max. | f max. | $d_a$(2) min. | $d_a$(2) max. | $D_a$(2) max. | $r_a$ max. | $D_x$ min. | $C_y$ max. | approx. |
| N | NR | 1.30 | 0.95 | 63.7 | 0.25 | 0.3 | 67.8 | 0.85 | 52 | 52.5 | 63 | 0.3 | 68.5 | 1.8 | 0.050 |
| N | NR | 1.70 | 0.95 | 70.7 | 0.25 | 0.5 | 74.8 | 0.85 | 54 | 55 | 68 | 0.6 | 76 | 2.3 | 0.135 |
| — | — | — | — | — | — | — | — | — | 54 | — | 76 | 0.6 | — | — | 0.175 |
| N | NR | 2.49 | 1.90 | 76.81 | 0.60 | 0.5 | 86.6 | 1.70 | 55 | 58.5 | 75 | 1 | 88 | 3.8 | 0.261 |
| — | — | — | — | — | — | — | — | — | 55 | 58.5 | 75 | 1 | — | — | 0.261 |
| N | NR | 3.28 | 2.70 | 86.79 | 0.60 | 0.5 | 96.5 | 2.46 | 56.5 | 60 | 83.5 | 1 | 98 | 5.4 | 0.459 |
| — | — | — | — | — | — | — | — | — | 56.5 | 60 | 83.5 | 1 | — | — | 0.459 |
| N | NR | 3.28 | 2.70 | 106.81 | 0.60 | 0.5 | 116.6 | 2.46 | 59 | 68 | 101 | 2 | 118 | 5.4 | 1.06 |
| — | — | — | — | — | — | — | — | — | 59 | 68 | 101 | 2 | — | — | 1.06 |
| N | NR | 1.70 | 0.95 | 70.7 | 0.25 | 0.3 | 74.8 | 0.85 | 57 | 59 | 70 | 0.3 | 76 | 2.3 | 0.081 |
| N | NR | 2.10 | 1.30 | 77.9 | 0.40 | 0.5 | 84.4 | 1.12 | 60 | 61.5 | 75 | 1 | 86 | 2.9 | 0.189 |
| — | — | — | — | — | — | — | — | — | 59 | — | 86 | 0.6 | — | — | 0.257 |
| N | NR | 2.87 | 2.70 | 86.79 | 0.60 | 0.5 | 96.5 | 2.46 | 61.5 | 64 | 83.5 | 1 | 98 | 5.0 | 0.381 |
| — | — | — | — | — | — | — | — | — | 61.5 | 64 | 83.5 | 1 | — | — | 0.381 |
| N | NR | 3.28 | 2.70 | 96.8 | 0.60 | 0.5 | 106.5 | 2.46 | 63 | 66.5 | 92 | 1.5 | 108 | 5.4 | 0.619 |
| — | — | — | — | — | — | — | — | — | 63 | 66.5 | 92 | 1.5 | — | — | 0.619 |
| N | NR | 4.06 | 3.10 | 115.21 | 0.60 | 0.5 | 129.7 | 2.82 | 64 | 72.5 | 111 | 2 | 131.5 | 6.5 | 1.37 |
| — | — | — | — | — | — | — | — | — | 64 | 72.5 | 111 | 2 | — | — | 1.37 |
| N | NR | 1.70 | 1.30 | 76.2 | 0.40 | 0.3 | 82.7 | 1.12 | 62 | 64 | 76 | 0.3 | 84 | 2.5 | 0.103 |
| N | NR | 2.10 | 1.30 | 82.9 | 0.40 | 0.5 | 89.4 | 1.12 | 65 | 66 | 80 | 1 | 91 | 2.9 | 0.192 |
| — | — | — | — | — | — | — | — | — | 64 | — | 91 | 0.6 | — | — | 0.281 |
| N | NR | 2.87 | 2.70 | 91.82 | 0.60 | 0.5 | 101.6 | 2.46 | 66.5 | 69 | 88.5 | 1 | 103 | 5.0 | 0.412 |
| — | — | — | — | — | — | — | — | — | 66.5 | 69 | 88.5 | 1 | — | — | 0.412 |
| N | NR | 3.28 | 2.70 | 106.81 | 0.60 | 0.5 | 116.6 | 2.46 | 68 | 74.5 | 102 | 1.5 | 118 | 5.4 | 0.783 |
| — | — | — | — | — | — | — | — | — | 68 | 74.5 | 102 | 1.5 | — | — | 0.783 |
| N | NR | 4.06 | 3.10 | 125.22 | 0.60 | 0.5 | 139.7 | 2.82 | 71 | 79 | 119 | 2 | 141.5 | 6.5 | 1.72 |
| — | — | — | — | — | — | — | — | — | 71 | 79 | 119 | 2 | — | — | 1.72 |

**Remarks**

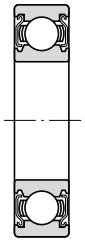
1. Diameter Series 7 (extra thin section bearings) are also available, please contact NSK.
2. When using bearings with rotating outer rings, contact NSK if they are sealed, shielded, or have snap rings.
3. Please consult NSK about the snap ring groove dimensions of sealed and shielded bearings when the diameter of dimension series 18 and 19 is 50 mm or more.
4. The bearings denoted by an asterisk(*) are NSKHPS Deep groove ball bearings.

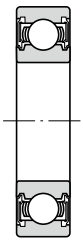
# Single-Row Deep Groove Ball Bearings

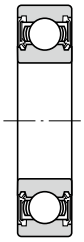
## Bore Diameter 65 – 75 mm

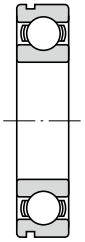


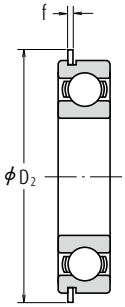
Open Type


Shielded Type
ZZ


Non-Contact
Sealed Type
VV


Contact
Sealed Type
DD · DDU

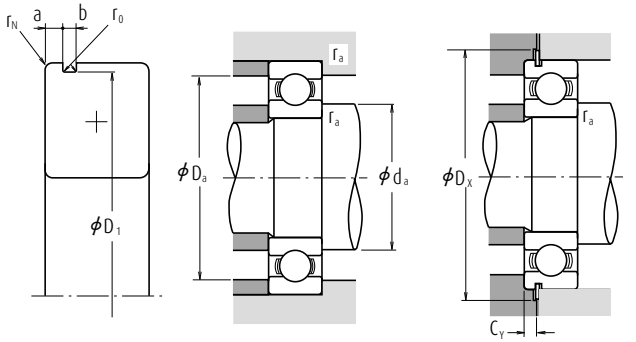

With Snap
Ring Groove
N



With
Snap Ring
NR

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Factor | Limiting Speeds (min⁻¹) | | | Bearing Numbers | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Grease | | Oil | | | | |
| d | D | B | r min. | $C_r$ | $C_{or}$ | $f_o$ | Open Z · ZZ V · VV | DU DDU | Open Z | Open | Shielded | Sealed | |
| **65** | 85 | 10 | 0.6 | 11 900 | 12 100 | 17.0 | 7 500 | 4 000 | 8 500 | **6813** | **ZZ** | **VV** | **DD** |
| | 90 | 13 | 1 | 17 400 | 16 100 | 16.6 | 7 100 | 4 000 | 8 500 | **6913** | **ZZ** | **VV** | **DDU** |
| | 100 | 11 | 0.6 | 20 500 | 18 700 | 16.5 | 6 700 | – | 8 000 | **16013** | – | – | – |
| | 100 | 18 | 1.1 | 30 500 | 25 200 | 15.8 | 6 700 | 4 000 | 8 000 | **6013** | **ZZ** | **VV** | **DDU** |
| | 100 | 18 | 1.1 | 32 000 | 25 200 | 15.8 | 7 500 | 4 000 | 9 000 | **6013*** | **ZZ** | **VV** | **DDU** |
| | 120 | 23 | 1.5 | 57 500 | 40 000 | 14.4 | 5 300 | 3 600 | 6 300 | **6213** | **ZZ** | **VV** | **DDU** |
| | 120 | 23 | 1.5 | 60 000 | 40 000 | 14.4 | 6 300 | 3 600 | 7 500 | **6213*** | **ZZ** | **VV** | **DDU** |
| | 140 | 33 | 2.1 | 92 500 | 60 000 | 13.2 | 4 800 | 3 400 | 6 000 | **6313** | **ZZ** | **VV** | **DDU** |
| | 140 | 33 | 2.1 | 97 500 | 60 000 | 13.2 | 5 600 | 3 400 | 6 700 | **6313*** | **ZZ** | **VV** | **DDU** |
| **70** | 90 | 10 | 0.6 | 12 100 | 12 700 | 17.2 | 6 700 | 3 800 | 8 000 | **6814** | **ZZ** | **VV** | **DD** |
| | 100 | 16 | 1 | 23 700 | 21 200 | 16.3 | 6 300 | 3 600 | 7 500 | **6914** | **ZZ** | **VV** | **DDU** |
| | 110 | 13 | 0.6 | 26 800 | 23 600 | 16.3 | 6 000 | – | 7 100 | **16014** | – | – | – |
| | 110 | 20 | 1.1 | 38 000 | 31 000 | 15.6 | 6 000 | 3 600 | 7 100 | **6014** | **ZZ** | **VV** | **DDU** |
| | 110 | 20 | 1.1 | 40 000 | 31 000 | 15.6 | 7 100 | 3 600 | 8 500 | **6014*** | **ZZ** | **VV** | **DDU** |
| | 125 | 24 | 1.5 | 62 000 | 44 000 | 14.5 | 5 000 | 3 400 | 6 300 | **6214** | **ZZ** | **VV** | **DDU** |
| | 125 | 24 | 1.5 | 65 500 | 44 000 | 14.5 | 6 000 | 3 400 | 7 100 | **6214*** | **ZZ** | **VV** | **DDU** |
| | 150 | 35 | 2.1 | 104 000 | 68 000 | 13.2 | 4 500 | 3 200 | 5 300 | **6314** | **ZZ** | **VV** | **DDU** |
| | 150 | 35 | 2.1 | 109 000 | 68 000 | 13.2 | 5 300 | 3 200 | 6 300 | **6314*** | **ZZ** | **VV** | **DDU** |
| **75** | 95 | 10 | 0.6 | 12 500 | 13 900 | 17.3 | 6 300 | 3 600 | 7 500 | **6815** | **ZZ** | **VV** | **DDU** |
| | 105 | 16 | 1 | 24 400 | 22 600 | 16.5 | 6 000 | 3 400 | 7 100 | **6915** | **ZZ** | **VV** | **DDU** |
| | 115 | 13 | 0.6 | 27 600 | 25 300 | 16.4 | 5 600 | – | 6 700 | **16015** | – | – | – |
| | 115 | 20 | 1.1 | 39 500 | 33 500 | 15.8 | 5 600 | 3 400 | 6 700 | **6015** | **ZZ** | **VV** | **DDU** |
| | 115 | 20 | 1.1 | 41 500 | 33 500 | 15.8 | 6 700 | 3 400 | 8 000 | **6015*** | **ZZ** | **VV** | **DDU** |
| | 130 | 25 | 1.5 | 66 000 | 49 500 | 14.7 | 4 800 | 3 200 | 5 600 | **6215** | **ZZ** | **VV** | **DDU** |
| | 130 | 25 | 1.5 | 69 500 | 49 500 | 14.7 | 5 600 | 3 200 | 6 700 | **6215*** | **ZZ** | **VV** | **DDU** |
| | 160 | 37 | 2.1 | 113 000 | 77 000 | 13.2 | 4 300 | 2 800 | 5 000 | **6315** | **ZZ** | **VV** | **DDU** |
| | 160 | 37 | 2.1 | 119 000 | 77 000 | 13.2 | 4 800 | 2 800 | 6 000 | **6315*** | **ZZ** | **VV** | **DDU** |

**Notes** (1) For tolerances for the snap ring grooves and snap ring dimensions, refer to Pages **A116** to **A119.**
(2) When heavy axial loads are applied, increase $d_a$ and decrease $D_a$ from the above values.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $\frac{f_0F_a}{C_{or}}$ | e | $\frac{F_a}{F_r}\leq e$ | | $\frac{F_a}{F_r}>e$ | |
|---|---|---|---|---|---|
| | | X | Y | X | Y |
| 0.172 | 0.19 | 1 | 0 | 0.56 | 2.30 |
| 0.345 | 0.22 | 1 | 0 | 0.56 | 1.99 |
| 0.689 | 0.26 | 1 | 0 | 0.56 | 1.71 |
| 1.03 | 0.28 | 1 | 0 | 0.56 | 1.55 |
| 1.38 | 0.30 | 1 | 0 | 0.56 | 1.45 |
| 2.07 | 0.34 | 1 | 0 | 0.56 | 1.31 |
| 3.45 | 0.38 | 1 | 0 | 0.56 | 1.15 |
| 5.17 | 0.42 | 1 | 0 | 0.56 | 1.04 |
| 6.89 | 0.44 | 1 | 0 | 0.56 | 1.00 |

## Static Equivalent Load

$\frac{F_a}{F_r} > 0.8$, $P_0=0.6F_r+0.5F_a$

$\frac{F_a}{F_r} \leq 0.8$, $P_0=F_r$

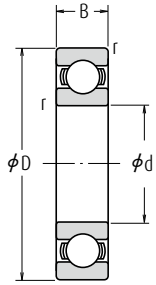
| With Snap Ring Groove | With Snap Ring | Snap Ring Groove Dimensions (1) (mm) | | | | | Snap Ring (1) Dimensions (mm) | | Abutment and Fillet Dimensions (mm) | | | | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | a max. | b min. | $D_1$ max. | $r_o$ max. | $r_N$ min. | $D_2$ max. | f max. | $d_a$(2) min. | $d_a$(2) max. | $D_a$(2) max. | $r_a$ max. | $D_x$ min. | $C_y$ max. | approx. |
| N | NR | 1.70 | 1.30 | 82.9 | 0.40 | 0.5 | 89.4 | 1.12 | 69 | 69 | 81 | 0.6 | 91 | 2.5 | 0.128 |
| N | NR | 2.10 | 1.30 | 87.9 | 0.40 | 0.5 | 94.4 | 1.12 | 70 | 71.5 | 85 | 1 | 96 | 2.9 | 0.218 |
| — | — | — | — | — | — | — | — | — | 69 | — | 96 | 0.6 | — | — | 0.30 |
| N | NR | 2.87 | 2.70 | 96.8 | 0.60 | 0.5 | 106.5 | 2.46 | 71.5 | 73 | 93.5 | 1 | 108 | 5.0 | 0.439 |
| — | — | — | — | — | — | — | — | — | 71.5 | 73 | 93.5 | 1 | — | — | 0.439 |
| N | NR | 4.06 | 3.10 | 115.21 | 0.60 | 0.5 | 129.7 | 2.82 | 73 | 80 | 112 | 1.5 | 131.5 | 6.5 | 1.0 |
| — | — | — | — | — | — | — | — | — | 73 | 80 | 112 | 1.5 | — | — | 1.0 |
| N | NR | 4.90 | 3.10 | 135.23 | 0.60 | 0.5 | 149.7 | 2.82 | 76 | 85.5 | 129 | 2 | 152 | 7.3 | 2.11 |
| — | — | — | — | — | — | — | — | — | 76 | 85.5 | 129 | 2 | — | — | 2.11 |
| N | NR | 1.70 | 1.30 | 87.9 | 0.40 | 0.5 | 94.4 | 1.12 | 74 | 74.5 | 86 | 0.6 | 96 | 2.5 | 0.134 |
| N | NR | 2.50 | 1.30 | 97.9 | 0.40 | 0.5 | 104.4 | 1.12 | 75 | 77.5 | 95 | 1 | 106 | 3.3 | 0.349 |
| — | — | — | — | — | — | — | — | — | 74 | — | 106 | 0.6 | — | — | 0.441 |
| N | NR | 2.87 | 2.70 | 106.81 | 0.60 | 0.5 | 116.6 | 2.46 | 76.5 | 80.5 | 103.5 | 1 | 118 | 5.0 | 0.608 |
| — | — | — | — | — | — | — | — | — | 76.5 | 80.5 | 103.5 | 1 | — | — | 0.608 |
| N | NR | 4.06 | 3.10 | 120.22 | 0.60 | 0.5 | 134.7 | 2.82 | 78 | 84 | 117 | 1.5 | 136.5 | 6.5 | 1.09 |
| — | — | — | — | — | — | — | — | — | 78 | 84 | 117 | 1.5 | — | — | 1.09 |
| N | NR | 4.90 | 3.10 | 145.24 | 0.60 | 0.5 | 159.7 | 2.82 | 81 | 92 | 139 | 2 | 162 | 7.3 | 2.57 |
| — | — | — | — | — | — | — | — | — | 81 | 92 | 139 | 2 | — | — | 2.57 |
| N | NR | 1.70 | 1.30 | 92.9 | 0.40 | 0.5 | 99.4 | 1.12 | 79 | 79.5 | 91 | 0.6 | 101 | 2.5 | 0.149 |
| N | NR | 2.50 | 1.30 | 102.60 | 0.40 | 0.5 | 110.7 | 1.12 | 80 | 82 | 100 | 1 | 112 | 3.3 | 0.364 |
| — | — | — | — | — | — | — | — | — | 79 | — | 111 | 0.6 | — | — | 0.463 |
| N | NR | 2.87 | 2.70 | 111.81 | 0.60 | 0.5 | 121.6 | 2.46 | 81.5 | 85.5 | 108.5 | 1 | 123 | 5.0 | 0.649 |
| — | — | — | — | — | — | — | — | — | 81.5 | 85.5 | 108.5 | 1 | — | — | 0.649 |
| N | NR | 4.06 | 3.10 | 125.22 | 0.60 | 0.5 | 139.7 | 2.82 | 83 | 90 | 122 | 1.5 | 141.5 | 6.5 | 1.19 |
| — | — | — | — | — | — | — | — | — | 83 | 90 | 122 | 1.5 | — | — | 1.19 |
| N | NR | 4.90 | 3.10 | 155.22 | 0.60 | 0.5 | 169.7 | 2.82 | 86 | 98.5 | 149 | 2 | 172 | 7.3 | 3.08 |
| — | — | — | — | — | — | — | — | — | 86 | 98.5 | 149 | 2 | — | — | 3.08 |

**Remarks**

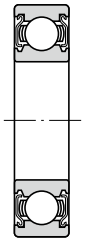
1. Diameter Series 7 (extra thin section bearings) are also available, please contact NSK.
2. When using bearings with rotating outer rings, contact NSK if they are sealed, shielded, or have snap rings.
3. Please consult NSK about the snap ring groove dimensions of sealed and shielded bearings when the diameter of dimension series 18 and 19 is 50 mm or more.
4. The bearings denoted by an asterisk(*) are NSKHPS Deep groove ball bearings.

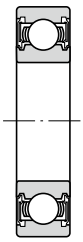
# Single-Row Deep Groove Ball Bearings

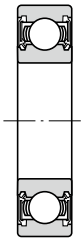
## Bore Diameter 80 – 90 mm

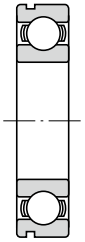


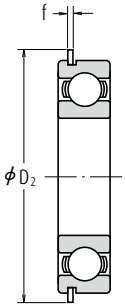
Open Type


Shielded Type
ZZ


Non-Contact
Sealed Type
VV


Contact
Sealed Type
DD · DDU

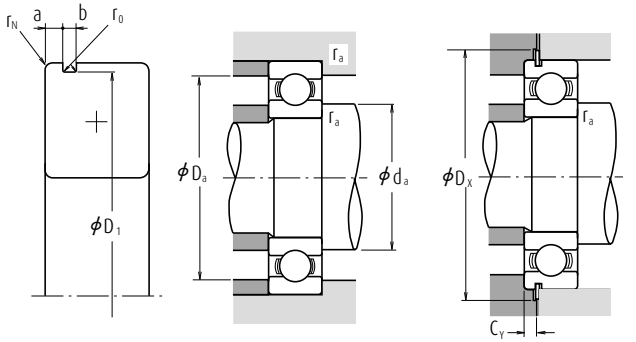

With Snap
Ring Groove
N



With
Snap Ring
NR

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Factor | Limiting Speeds (min⁻¹) | | | Bearing Numbers | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Grease | | Oil | | | | |
| d | D | B | r min. | $C_r$ | $C_{or}$ | $f_o$ | Open Z · ZZ V · VV | DU DDU | Open Z | Open | Shielded | Sealed | |
| **80** | 100 | 10 | 0.6 | 12 700 | 14 500 | 17.4 | 6 000 | 3 400 | 7 100 | **6816** | **ZZ** | **VV** | **DDU** |
| | 110 | 16 | 1 | 25 000 | 24 000 | 16.6 | 5 600 | 3 200 | 6 700 | **6916** | **ZZ** | **VV** | **DDU** |
| | 125 | 14 | 0.6 | 32 000 | 29 600 | 16.4 | 5 300 | – | 6 300 | **16016** | – | – | – |
| | 125 | 22 | 1.1 | 47 500 | 40 000 | 15.6 | 5 300 | 3 200 | 6 300 | **6016** | **ZZ** | **VV** | **DDU** |
| | 125 | 22 | 1.1 | 50 000 | 40 000 | 15.6 | 6 300 | 3 200 | 7 100 | **6016*** | **ZZ** | **VV** | **DDU** |
| | 140 | 26 | 2 | 72 500 | 53 000 | 14.6 | 4 500 | 3 000 | 5 300 | **6216** | **ZZ** | **VV** | **DDU** |
| | 140 | 26 | 2.0 | 76 500 | 53 000 | 14.6 | 5 300 | 3 000 | 6 300 | **6216*** | **ZZ** | **VV** | **DDU** |
| | 170 | 39 | 2.1 | 123 000 | 86 500 | 13.3 | 4 000 | 2 800 | 4 800 | **6316** | **ZZ** | **VV** | **DDU** |
| | 170 | 39 | 2.1 | 129 000 | 86 500 | 13.3 | 4 500 | 2 800 | 5 600 | **6316*** | **ZZ** | **VV** | **DDU** |
| **85** | 110 | 13 | 1 | 18 700 | 20 000 | 17.1 | 5 600 | 3 200 | 6 700 | **6817** | **ZZ** | **VV** | **DDU** |
| | 120 | 18 | 1.1 | 32 000 | 29 600 | 16.4 | 5 300 | 3 000 | 6 300 | **6917** | **ZZ** | **VV** | **DDU** |
| | 130 | 14 | 0.6 | 33 000 | 31 500 | 16.5 | 5 000 | – | 6 000 | **16017** | – | – | – |
| | 130 | 22 | 1.1 | 49 500 | 43 000 | 15.8 | 5 000 | 3 000 | 6 000 | **6017** | **ZZ** | **VV** | **DDU** |
| | 130 | 22 | 1.1 | 52 000 | 43 000 | 15.8 | 6 000 | 3 000 | 7 100 | **6017*** | **ZZ** | **VV** | **DDU** |
| | 150 | 28 | 2 | 84 000 | 62 000 | 14.5 | 4 300 | 2 800 | 5 000 | **6217** | **ZZ** | **VV** | **DDU** |
| | 150 | 28 | 2.0 | 88 000 | 62 000 | 14.5 | 4 800 | 2 800 | 6 000 | **6217*** | **ZZ** | **VV** | **DDU** |
| | 180 | 41 | 3 | 133 000 | 97 000 | 13.3 | 3 800 | 2 600 | 4 500 | **6317** | **ZZ** | **VV** | **DDU** |
| | 180 | 41 | 3.0 | 139 000 | 97 000 | 13.3 | 4 300 | 2 600 | 5 000 | **6317*** | **ZZ** | **VV** | **DDU** |
| **90** | 115 | 13 | 1 | 19 000 | 21 000 | 17.2 | 5 300 | 3 000 | 6 300 | **6818** | **ZZ** | **VV** | **DDU** |
| | 125 | 18 | 1.1 | 33 000 | 31 500 | 16.5 | 5 000 | 2 800 | 6 000 | **6918** | **ZZ** | **VV** | **DDU** |
| | 140 | 16 | 1 | 41 500 | 39 500 | 16.3 | 4 800 | – | 5 600 | **16018** | – | – | – |
| | 140 | 24 | 1.5 | 58 000 | 50 000 | 15.6 | 4 800 | 2 800 | 5 600 | **6018** | **ZZ** | **VV** | **DDU** |
| | 140 | 24 | 1.5 | 61 000 | 50 000 | 15.6 | 5 600 | 2 800 | 6 300 | **6018*** | **ZZ** | **VV** | **DDU** |
| | 160 | 30 | 2 | 96 000 | 71 500 | 14.5 | 4 000 | 2 600 | 4 800 | **6218** | **ZZ** | **VV** | **DDU** |
| | 160 | 30 | 2.0 | 101 000 | 71 500 | 14.5 | 4 500 | 2 600 | 5 600 | **6218*** | **ZZ** | **VV** | **DDU** |
| | 190 | 43 | 3 | 143 000 | 107 000 | 13.3 | 3 600 | 2 400 | 4 300 | **6318** | **ZZ** | **VV** | **DDU** |
| | 190 | 43 | 3.0 | 150 000 | 107 000 | 13.3 | 4 000 | 2 400 | 4 800 | **6318*** | **ZZ** | **VV** | **DDU** |

**Notes** (1) For tolerances for the snap ring grooves and snap ring dimensions, refer to Pages **A116** to **A119.**
(2) When heavy axial loads are applied, increase $d_a$ and decrease $D_a$ from the above values.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $\frac{f_oF_a}{C_{or}}$ | e | $\frac{F_a}{F_r}\leq e$ | | $\frac{F_a}{F_r}>e$ | |
|---|---|---|---|---|---|
| | | X | Y | X | Y |
| 0.172 | 0.19 | 1 | 0 | 0.56 | 2.30 |
| 0.345 | 0.22 | 1 | 0 | 0.56 | 1.99 |
| 0.689 | 0.26 | 1 | 0 | 0.56 | 1.71 |
| 1.03 | 0.28 | 1 | 0 | 0.56 | 1.55 |
| 1.38 | 0.30 | 1 | 0 | 0.56 | 1.45 |
| 2.07 | 0.34 | 1 | 0 | 0.56 | 1.31 |
| 3.45 | 0.38 | 1 | 0 | 0.56 | 1.15 |
| 5.17 | 0.42 | 1 | 0 | 0.56 | 1.04 |
| 6.89 | 0.44 | 1 | 0 | 0.56 | 1.00 |

## Static Equivalent Load

$\frac{F_a}{F_r}>0.8$, $P_0=0.6F_r+0.5F_a$

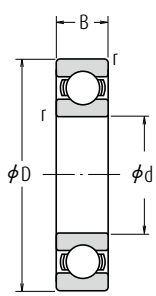
$\frac{F_a}{F_r}\leq 0.8$, $P_0=F_r$

| With Snap Ring Groove | With Snap Ring | Snap Ring Groove Dimensions (1) (mm) a max. | b min. | $D_1$ max. | $r_o$ max. | $r_N$ min. | Snap Ring (1) Dimensions (mm) $D_2$ max. | f max. | Abutment and Fillet Dimensions (mm) $d_a$(2) min. | $d_a$(2) max. | $D_a$(2) max. | $r_a$ max. | $D_x$ min. | $C_y$ max. | Mass (kg) approx. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N | NR | 1.70 | 1.3 | 97.9 | 0.4 | 0.5 | 104.4 | 1.12 | 84 | 84.5 | 96 | 0.6 | 106 | 2.5 | 0.151 |
| N | NR | 2.50 | 1.3 | 107.60 | 0.4 | 0.5 | 115.7 | 1.12 | 85 | 87.5 | 105 | 1 | 117 | 3.3 | 0.391 |
| — | — | — | — | — | — | — | — | — | 84 | — | 121 | 0.6 | — | — | 0.621 |
| N | NR | 2.87 | 3.1 | 120.22 | 0.6 | 0.5 | 134.7 | 2.82 | 86.5 | 91 | 118.5 | 1 | 136.5 | 5.3 | 0.872 |
| — | — | — | — | — | — | — | — | — | 86.5 | 91 | 118.5 | 1 | — | — | 0.872 |
| N | NR | 4.90 | 3.1 | 135.23 | 0.6 | 0.5 | 149.7 | 2.82 | 89 | 95.5 | 131 | 2 | 152 | 7.3 | 1.42 |
| — | — | — | — | — | — | — | — | — | 89 | 95.5 | 131 | 2 | — | — | 1.42 |
| N | NR | 5.69 | 3.5 | 163.65 | 0.6 | 0.5 | 182.9 | 3.10 | 91 | 104.5 | 159 | 2 | 185 | 8.4 | 3.67 |
| — | — | — | — | — | — | — | — | — | 91 | 104.5 | 159 | 2 | — | — | 3.67 |
| N | NR | 2.10 | 1.3 | 107.60 | 0.4 | 0.5 | 115.7 | 1.12 | 90 | 90.5 | 105 | 1 | 117 | 2.9 | 0.263 |
| N | NR | 3.30 | 1.3 | 117.60 | 0.4 | 0.5 | 125.7 | 1.12 | 91.5 | 94.5 | 113.5 | 1 | 127 | 4.1 | 0.55 |
| — | — | — | — | — | — | — | — | — | 89 | — | 126 | 0.6 | — | — | 0.652 |
| N | NR | 2.87 | 3.1 | 125.22 | 0.6 | 0.5 | 139.7 | 2.82 | 91.5 | 96 | 123.5 | 1 | 141.5 | 5.3 | 0.918 |
| — | — | — | — | — | — | — | — | — | 91.5 | 96 | 123.5 | 1 | — | — | 0.918 |
| N | NR | 4.90 | 3.1 | 145.24 | 0.6 | 0.5 | 159.7 | 2.82 | 94 | 102 | 141 | 2 | 162 | 7.3 | 1.76 |
| — | — | — | — | — | — | — | — | — | 94 | 102 | 141 | 2 | — | — | 1.76 |
| N | NR | 5.69 | 3.5 | 173.66 | 0.6 | 0.5 | 192.9 | 3.10 | 98 | 110.5 | 167 | 2.5 | 195 | 8.4 | 4.28 |
| — | — | — | — | — | — | — | — | — | 98 | 110.5 | 167 | 2.5 | — | — | 4.28 |
| N | NR | 2.10 | 1.3 | 112.60 | 0.4 | 0.5 | 120.7 | 1.12 | 95 | 95.5 | 110 | 1 | 122 | 2.9 | 0.276 |
| N | NR | 3.30 | 1.3 | 122.60 | 0.4 | 0.5 | 130.7 | 1.12 | 96.5 | 98.5 | 118.5 | 1 | 132 | 4.1 | 0.585 |
| — | — | — | — | — | — | — | — | — | 95 | — | 135 | 1 | — | — | 0.873 |
| N | NR | 3.71 | 3.1 | 135.23 | 0.6 | 0.5 | 149.7 | 2.82 | 98 | 103 | 132 | 1.5 | 152 | 6.1 | 1.19 |
| — | — | — | — | — | — | — | — | — | 98 | 103 | 132 | 1.5 | — | — | 1.19 |
| N | NR | 4.90 | 3.1 | 155.22 | 0.6 | 0.5 | 169.7 | 2.82 | 99 | 107.5 | 151 | 2 | 172 | 7.3 | 2.18 |
| — | — | — | — | — | — | — | — | — | 99 | 107.5 | 151 | 2 | — | — | 2.18 |
| N | NR | 5.69 | 3.5 | 183.64 | 0.6 | 0.5 | 202.9 | 3.10 | 103 | 117 | 177 | 2.5 | 205 | 8.4 | 4.98 |
| — | — | — | — | — | — | — | — | — | 103 | 117 | 177 | 2.5 | — | — | 4.98 |

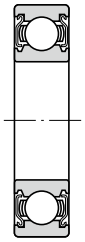
**Remarks**

1. Diameter Series 7 (extra thin section bearings) are also available, please contact NSK.
2. When using bearings with rotating outer rings, contact NSK if they are sealed, shielded, or have snap rings.
3. Please consult NSK about the snap ring groove dimensions of sealed and shielded bearings when the diameter of dimension series 18 and 19 is 50 mm or more.
4. The bearings denoted by an asterisk(*) are NSKHPS Deep groove ball bearings.

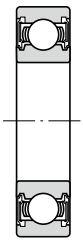
## Bore Diameter 95 – 105 mm



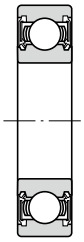

Open Type



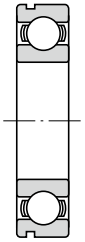
Shielded Type
ZZ · ZZS



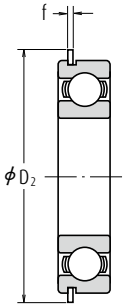
Non-Contact
Sealed Type
VV



Contact
Sealed Type
DD · DDU



With Snap
Ring Groove
N



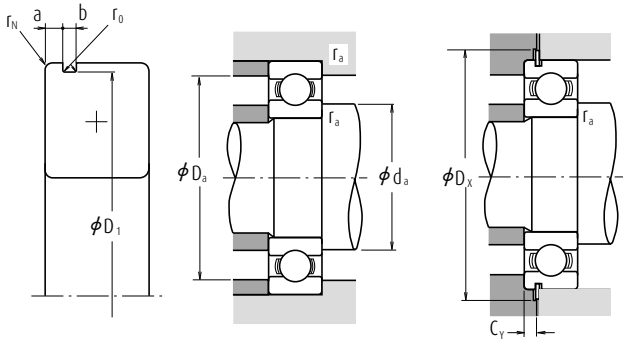

With
Snap Ring
NR

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Factor | Limiting Speeds (min⁻¹) | | | Bearing Numbers | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Grease | | Oil | | | | |
| d | D | B | r min. | $C_r$ | $C_{or}$ | $f_o$ | Open Z · ZZ V · VV | DU DDU | Open Z | Open | Shielded | Sealed | |
| **95** | 120 | 13 | 1 | 19 300 | 22 000 | 17.2 | 5 000 | 2 800 | 6 000 | **6819** | **ZZ** | **VV** | **DD** |
| | 130 | 18 | 1.1 | 33 500 | 33 500 | 16.6 | 4 800 | 2 800 | 5 600 | **6919** | **ZZ** | **VV** | **DDU** |
| | 145 | 16 | 1 | 43 000 | 42 000 | 16.4 | 4 500 | – | 5 300 | **16019** | – | – | – |
| | 145 | 24 | 1.5 | 60 500 | 54 000 | 15.8 | 4 500 | 2 600 | 5 300 | **6019** | **ZZ** | **VV** | **DDU** |
| | 145 | 24 | 1.5 | 63 500 | 54 000 | 15.8 | 5 300 | 2 600 | 6 000 | **6019*** | **ZZ** | **VV** | **DDU** |
| | 170 | 32 | 2.1 | 109 000 | 82 000 | 14.4 | 3 800 | 2 600 | 4 500 | **6219** | **ZZ** | **VV** | **DDU** |
| | 170 | 32 | 2.1 | 114 000 | 82 000 | 14.4 | 4 300 | 2 600 | 5 000 | **6219*** | **ZZ** | **VV** | **DDU** |
| | 200 | 45 | 3 | 153 000 | 119 000 | 13.3 | 3 000 | 2 400 | 3 600 | **6319** | **ZZ** | **VV** | **DDU** |
| | 200 | 45 | 3.0 | 160 000 | 119 000 | 13.3 | 3 400 | 2 400 | 4 300 | **6319*** | **ZZ** | **VV** | **DDU** |
| **100** | 125 | 13 | 1 | 19 600 | 23 000 | 17.3 | 4 800 | 2 800 | 5 600 | **6820** | **ZZ** | **VV** | **DD** |
| | 140 | 20 | 1.1 | 43 000 | 42 000 | 16.4 | 4 500 | 2 600 | 5 300 | **6920** | **ZZ** | **VV** | **DDU** |
| | 150 | 16 | 1 | 42 500 | 42 000 | 16.5 | 4 300 | – | 5 300 | **16020** | – | – | – |
| | 150 | 24 | 1.5 | 60 000 | 54 000 | 15.9 | 4 300 | 2 600 | 5 300 | **6020** | **ZZ** | **VV** | **DDU** |
| | 150 | 24 | 1.5 | 63 000 | 54 000 | 15.9 | 5 000 | 2 600 | 6 000 | **6020*** | **ZZ** | **VV** | **DDU** |
| | 180 | 34 | 2.1 | 122 000 | 93 000 | 14.4 | 3 600 | 2 400 | 4 300 | **6220** | **ZZ** | **VV** | **DDU** |
| | 180 | 34 | 2.1 | 128 000 | 93 000 | 14.4 | 4 000 | 2 400 | 4 800 | **6220*** | **ZZ** | **VV** | **DDU** |
| | 215 | 47 | 3 | 173 000 | 141 000 | 13.2 | 2 800 | 2 200 | 3 400 | **6320** | **ZZ** | **VV** | **DDU** |
| **105** | 130 | 13 | 1 | 19 800 | 23 900 | 17.4 | 4 800 | 2 600 | 5 600 | **6821** | **ZZ** | **VV** | **DDU** |
| | 145 | 20 | 1.1 | 42 500 | 42 000 | 16.5 | 4 300 | – | 5 300 | **6921** | **ZZ** | **VV** | – |
| | 160 | 18 | 1 | 52 000 | 50 500 | 16.3 | 4 000 | – | 4 800 | **16021** | – | – | – |
| | 160 | 26 | 2 | 72 500 | 66 000 | 15.8 | 4 000 | 2 400 | 4 800 | **6021** | **ZZ** | **VV** | **DDU** |
| | 160 | 26 | 2.0 | 76 000 | 66 000 | 15.8 | 4 500 | 2 400 | 5 600 | **6021*** | **ZZ** | **VV** | **DDU** |
| | 190 | 36 | 2.1 | 133 000 | 105 000 | 14.4 | 3 400 | 2 200 | 4 000 | **6221** | **ZZ** | **VV** | **DDU** |
| | 190 | 36 | 2.1 | 140 000 | 105 000 | 14.4 | 3 800 | 2 200 | 4 500 | **6221*** | **ZZ** | **VV** | **DDU** |
| | 225 | 49 | 3 | 184 000 | 154 000 | 13.2 | 2 600 | 2 000 | 3 200 | **6321** | **ZZ** | – | **DDU** |

**Notes**

(1) For tolerances for the snap ring grooves and snap ring dimensions, refer to Pages **A116** to **A119.**

(2) When heavy axial loads are applied, increase $d_a$ and decrease $D_a$ from the above values.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $\frac{f_0F_a}{C_{or}}$ | e | $\frac{F_a}{F_r}\leq e$ | | $\frac{F_a}{F_r}>e$ | |
|---|---|---|---|---|---|
| | | X | Y | X | Y |
| 0.172 | 0.19 | 1 | 0 | 0.56 | 2.30 |
| 0.345 | 0.22 | 1 | 0 | 0.56 | 1.99 |
| 0.689 | 0.26 | 1 | 0 | 0.56 | 1.71 |
| 1.03 | 0.28 | 1 | 0 | 0.56 | 1.55 |
| 1.38 | 0.30 | 1 | 0 | 0.56 | 1.45 |
| 2.07 | 0.34 | 1 | 0 | 0.56 | 1.31 |
| 3.45 | 0.38 | 1 | 0 | 0.56 | 1.15 |
| 5.17 | 0.42 | 1 | 0 | 0.56 | 1.04 |
| 6.89 | 0.44 | 1 | 0 | 0.56 | 1.00 |

## Static Equivalent Load

$\frac{F_a}{F_r} > 0.8$, $P_0=0.6F_r+0.5F_a$

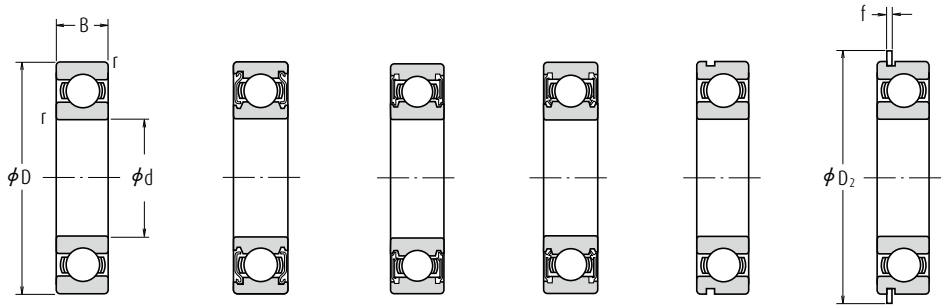
$\frac{F_a}{F_r} \leq 0.8$, $P_0=F_r$

| With Snap Ring Groove | With Snap Ring | Snap Ring Groove Dimensions (1) (mm) | | | | | Snap Ring (1) Dimensions (mm) | | Abutment and Fillet Dimensions (mm) | | | | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | a max. | b min. | $D_1$ max. | $r_o$ max. | $r_N$ min. | $D_2$ max. | f max. | $d_a$(2) min. | $d_a$(2) max. | $D_a$(2) max. | $r_a$ max. | $D_x$ min. | $C_y$ max. | approx. |
| N | NR | 2.10 | 1.3 | 117.60 | 0.4 | 0.5 | 125.7 | 1.12 | 100 | 101.5 | 115 | 1 | 127 | 2.9 | 0.297 |
| N | NR | 3.30 | 1.3 | 127.60 | 0.4 | 0.5 | 135.7 | 1.12 | 101.5 | 103.5 | 123.5 | 1 | 137 | 4.1 | 0.601 |
| — | — | — | — | — | — | — | — | — | 100 | — | 140 | 1 | — | — | 0.904 |
| N | NR | 3.71 | 3.1 | 140.23 | 0.6 | 0.5 | 154.7 | 2.82 | 103 | 108.5 | 137 | 1.5 | 157 | 6.1 | 1.23 |
| — | — | — | — | — | — | — | — | — | 103 | 108.5 | 137 | 1.5 | — | — | 1.23 |
| N | NR | 5.69 | 3.5 | 163.65 | 0.6 | 0.5 | 182.9 | 3.10 | 106 | 114 | 159 | 2 | 185 | 8.4 | 2.64 |
| — | — | — | — | — | — | — | — | — | 106 | 114 | 159 | 2 | — | — | 2.64 |
| N | NR | 5.69 | 3.5 | 193.65 | 0.6 | 0.5 | 212.9 | 3.10 | 108 | 123.5 | 187 | 2.5 | 215 | 8.4 | 5.76 |
| — | — | — | — | — | — | — | — | — | 108 | 123.5 | 187 | 2.5 | — | — | 5.76 |
| N | NR | 2.10 | 1.3 | 122.60 | 0.4 | 0.5 | 130.7 | 1.12 | 105 | 105.5 | 120 | 1 | 132 | 2.9 | 0.31 |
| N | NR | 3.30 | 1.9 | 137.60 | 0.6 | 0.5 | 145.7 | 1.70 | 106.5 | 111 | 133.5 | 1 | 147 | 4.7 | 0.828 |
| — | — | — | — | — | — | — | — | — | 105 | — | 145 | 1 | — | — | 0.945 |
| N | NR | 3.71 | 3.1 | 145.24 | 0.6 | 0.5 | 159.7 | 2.82 | 108 | 112.5 | 142 | 1.5 | 162 | 6.1 | 1.29 |
| — | — | — | — | — | — | — | — | — | 108 | 112.5 | 142 | 1.5 | — | — | 1.29 |
| N | NR | 5.69 | 3.5 | 173.66 | 0.6 | 0.5 | 192.9 | 3.10 | 111 | 121.5 | 169 | 2 | 195 | 8.4 | 3.17 |
| — | — | — | — | — | — | — | — | — | 111 | 121.5 | 169 | 2 | — | — | 3.17 |
| — | — | — | — | — | — | — | — | — | 113 | 133 | 202 | 2.5 | — | — | 7.04 |
| N | NR | 2.10 | 1.3 | 127.60 | 0.4 | 0.5 | 135.7 | 1.12 | 110 | 110.5 | 125 | 1 | 137 | 2.9 | 0.324 |
| N | NR | 3.30 | 1.9 | 142.60 | 0.6 | 0.5 | 150.7 | 1.70 | 111.5 | 116 | 138.5 | 1 | 152 | 4.7 | 0.856 |
| — | — | — | — | — | — | — | — | — | 110 | — | 155 | 1 | — | — | 1.24 |
| N | NR | 3.71 | 3.1 | 155.22 | 0.6 | 0.5 | 169.7 | 2.82 | 114 | 120 | 151 | 2 | 172 | 6.1 | 1.58 |
| — | — | — | — | — | — | — | — | — | 114 | 120 | 151 | 2 | — | — | 1.58 |
| N | NR | 5.69 | 3.5 | 183.64 | 0.6 | 0.5 | 202.9 | 3.10 | 116 | 127.5 | 179 | 2 | 205 | 8.4 | 3.79 |
| — | — | — | — | — | — | — | — | — | 116 | 127.5 | 179 | 2 | — | — | 3.79 |
| — | — | — | — | — | — | — | — | — | 118 | 138 | 212 | 2.5 | — | — | 8.09 |

**Remarks**

1. Diameter Series 7 (extra thin section bearings) are also available, please contact NSK.
2. When using bearings with rotating outer rings, contact NSK if they are sealed, shielded, or have snap rings.
3. Please consult NSK about the snap ring groove dimensions of sealed and shielded bearings when the diameter of dimension series 18 and 19 is 50 mm or more.
4. The bearings denoted by an asterisk(*) are NSKHPS Deep groove ball bearings.

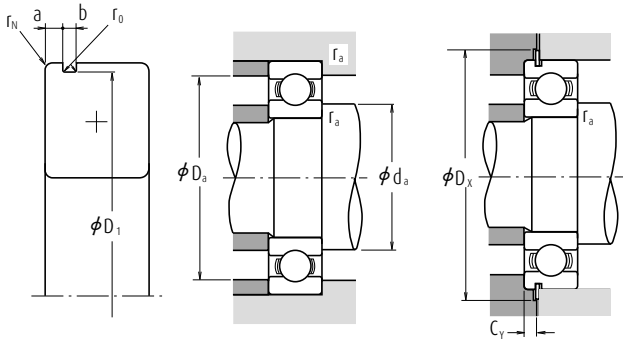
## Bore Diameter 110 – 150 mm




Open Type | Shielded Type ZZ · ZZS | Non-Contact Sealed Type VV | Contact Sealed Type DD · DDU | With Snap Ring Groove N | With Snap Ring NR

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Factor | Limiting Speeds (min⁻¹) | | | Bearing Numbers | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Grease | | Oil | | | | |
| d | D | B | r min. | $C_r$ | $C_{or}$ | $f_o$ | Open Z · ZZ V · VV | DU DDU | Open Z | Open | Shielded | Sealed | |
| **110** | 140 | 16 | 1 | 28 100 | 32 500 | 17.1 | 4 300 | 2 400 | 5 300 | **6822** | **ZZ** | **VV** | **DDU** |
| | 150 | 20 | 1.1 | 43 500 | 44 500 | 16.6 | 4 300 | 2 400 | 5 000 | **6922** | **ZZ** | **VV** | **DDU** |
| | 170 | 19 | 1 | 57 500 | 56 500 | 16.3 | 3 800 | – | 4 500 | **16022** | – | – | – |
| | 170 | 28 | 2 | 85 000 | 73 000 | 15.5 | 3 800 | 2 200 | 4 500 | **6022** | **ZZ** | **VV** | **DDU** |
| | 170 | 28 | 2.0 | 89 000 | 73 000 | 15.5 | 4 500 | 2 200 | 5 300 | **6022*** | **ZZ** | **VV** | **DDU** |
| | 200 | 38 | 2.1 | 144 000 | 117 000 | 14.3 | 2 800 | 2 200 | 3 400 | **6222** | **ZZ** | **VV** | **DDU** |
| | 240 | 50 | 3 | 205 000 | 179 000 | 13.2 | 2 400 | – | 3 000 | **6322** | **ZZ** | – | – |
| **120** | 150 | 16 | 1 | 28 900 | 35 500 | 17.3 | 4 000 | 2 200 | 4 800 | **6824** | **ZZ** | **VV** | **DD** |
| | 165 | 22 | 1.1 | 53 000 | 54 000 | 16.5 | 3 800 | – | 4 500 | **6924** | **ZZ** | – | – |
| | 180 | 19 | 1 | 56 500 | 57 500 | 16.5 | 3 600 | – | 4 300 | **16024** | – | – | – |
| | 180 | 28 | 2 | 88 000 | 80 000 | 15.7 | 3 600 | 2 200 | 4 300 | **6024** | **ZZ** | **VV** | **DDU** |
| | 180 | 28 | 2.0 | 92 500 | 80 000 | 15.7 | 4 000 | 2 200 | 4 800 | **6024*** | **ZZ** | **VV** | **DDU** |
| | 215 | 40 | 2.1 | 155 000 | 131 000 | 14.4 | 2 600 | 2 000 | 3 200 | **6224** | **ZZ** | **VV** | **DDU** |
| | 260 | 55 | 3 | 207 000 | 185 000 | 13.5 | 2 200 | 1 800 | 2 800 | **6324** | **ZZS** | – | **DDU** |
| **130** | 165 | 18 | 1.1 | 37 000 | 44 000 | 17.1 | 3 600 | 2 000 | 4 300 | **6826** | **ZZS** | **VV** | **DD** |
| | 180 | 24 | 1.5 | 65 000 | 67 500 | 16.5 | 3 400 | – | 4 000 | **6926** | **ZZ** | – | – |
| | 200 | 22 | 1.1 | 75 500 | 77 500 | 16.4 | 3 000 | – | 3 600 | **16026** | – | – | – |
| | 200 | 33 | 2 | 106 000 | 101 000 | 15.8 | 3 000 | 1 900 | 3 600 | **6026** | **ZZ** | – | **DDU** |
| | 230 | 40 | 3 | 167 000 | 146 000 | 14.5 | 2 400 | – | 3 000 | **6226** | **ZZ** | – | – |
| | 280 | 58 | 4 | 229 000 | 214 000 | 13.6 | 2 200 | – | 2 600 | **6326** | **ZZS** | – | – |
| **140** | 175 | 18 | 1.1 | 38 500 | 48 000 | 17.3 | 3 400 | 1 900 | 4 000 | **6828** | **ZZ** | **VV** | **DDU** |
| | 190 | 24 | 1.5 | 66 500 | 72 000 | 16.6 | 3 200 | – | 3 800 | **6928** | **ZZS** | **VV** | – |
| | 210 | 22 | 1.1 | 77 500 | 82 500 | 16.5 | 2 800 | – | 3 400 | **16028** | – | – | – |
| | 210 | 33 | 2 | 110 000 | 109 000 | 16.0 | 2 800 | 1 800 | 3 400 | **6028** | **ZZ** | – | **DDU** |
| | 250 | 42 | 3 | 166 000 | 150 000 | 14.9 | 2 200 | 1 700 | 2 800 | **6228** | **ZZS** | – | **DDU** |
| | 300 | 62 | 4 | 253 000 | 246 000 | 13.6 | 2 000 | – | 2 400 | **6328** | **ZZS** | – | – |
| **150** | 190 | 20 | 1.1 | 47 500 | 58 500 | 17.1 | 3 200 | 1 800 | 3 800 | **6830** | **ZZ** | **VV** | **DDU** |
| | 210 | 28 | 2 | 85 000 | 90 500 | 16.5 | 2 600 | 1 700 | 3 200 | **6930** | **ZZS** | – | **DDU** |
| | 225 | 24 | 1.1 | 84 000 | 91 000 | 16.6 | 2 600 | – | 3 000 | **16030** | – | – | – |
| | 225 | 35 | 2.1 | 126 000 | 126 000 | 15.9 | 2 600 | 1 700 | 3 000 | **6030** | **ZZ** | **VV** | **DDU** |
| | 270 | 45 | 3 | 176 000 | 168 000 | 15.1 | 2 000 | – | 2 600 | **6230** | **ZZS** | – | – |
| | 320 | 65 | 4 | 274 000 | 284 000 | 13.9 | 1 800 | – | 2 200 | **6330** | **ZZS** | – | – |

**Notes** (1) For tolerances for the snap ring grooves and snap ring dimensions, refer to Pages **A116** to **A119.**
(2) When heavy axial loads are applied, increase $d_a$ and decrease $D_a$ from the above values.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $\frac{f_0F_a}{C_{or}}$ | e | $\frac{F_a}{F_r}\leq e$ | | $\frac{F_a}{F_r}>e$ | |
|---|---|---|---|---|---|
| | | X | Y | X | Y |
| 0.172 | 0.19 | 1 | 0 | 0.56 | 2.30 |
| 0.345 | 0.22 | 1 | 0 | 0.56 | 1.99 |
| 0.689 | 0.26 | 1 | 0 | 0.56 | 1.71 |
| 1.03 | 0.28 | 1 | 0 | 0.56 | 1.55 |
| 1.38 | 0.30 | 1 | 0 | 0.56 | 1.45 |
| 2.07 | 0.34 | 1 | 0 | 0.56 | 1.31 |
| 3.45 | 0.38 | 1 | 0 | 0.56 | 1.15 |
| 5.17 | 0.42 | 1 | 0 | 0.56 | 1.04 |
| 6.89 | 0.44 | 1 | 0 | 0.56 | 1.00 |

## Static Equivalent Load

$\frac{F_a}{F_r}>0.8$, $P_0=0.6F_r+0.5F_a$

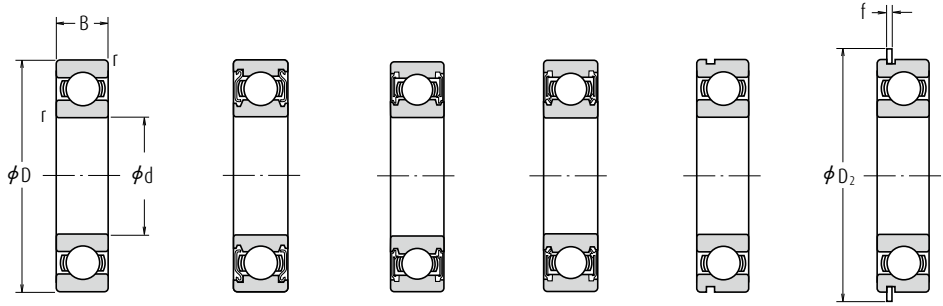
$\frac{F_a}{F_r}\leq 0.8$, $P_0=F_r$

| With Snap Ring Groove | With Snap Ring | Snap Ring Groove Dimensions (1) (mm) a max. | b min. | $D_1$ max. | $r_0$ max. | $r_N$ min. | Snap Ring (1) Dimensions (mm) $D_2$ max. | f max. | Abutment and Fillet Dimensions (mm) $d_a$(2) min. | $d_a$(2) max. | $D_a$(2) max. | $r_a$ max. | $D_x$ min. | $C_y$ max. | Mass (kg) approx. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N | NR | 2.50 | 1.9 | 137.60 | 0.6 | 0.5 | 145.7 | 1.7 | 115 | 117 | 135 | 1 | 147 | 3.9 | 0.497 |
| N | NR | 3.30 | 1.9 | 147.60 | 0.6 | 0.5 | 155.7 | 1.7 | 116.5 | 121 | 143.5 | 1 | 157 | 4.7 | 0.893 |
| — | — | — | — | — | — | — | — | — | 115 | — | 165 | 1 | — | — | 1.51 |
| N | NR | 3.71 | 3.5 | 163.65 | 0.6 | 0.5 | 182.9 | 3.1 | 119 | 124.5 | 161 | 2 | 185 | 6.4 | 1.94 |
| — | — | — | — | — | — | — | — | — | 119 | 124.5 | 161 | 2 | — | — | 1.94 |
| N | NR | 5.69 | 3.5 | 193.65 | 0.6 | 0.5 | 212.9 | 3.1 | 121 | 134 | 189 | 2 | 215 | 8.4 | 4.45 |
| — | — | — | — | — | — | — | — | — | 123 | 147 | 227 | 2.5 | — | — | 9.51 |
| N | NR | 2.50 | 1.9 | 147.60 | 0.6 | 0.5 | 155.7 | 1.7 | 125 | 127 | 145 | 1 | 157 | 3.9 | 0.537 |
| N | NR | 3.70 | 1.9 | 161.80 | 0.6 | 0.5 | 171.5 | 1.7 | 126.5 | 132 | 158.5 | 1 | 173 | 5.1 | 1.21 |
| — | — | — | — | — | — | — | — | — | 125 | — | 175 | 1 | — | — | 1.6 |
| N | NR | 3.71 | 3.5 | 173.66 | 0.6 | 0.5 | 192.9 | 3.1 | 129 | 134.5 | 171 | 2 | 195 | 6.4 | 2.08 |
| — | — | — | — | — | — | — | — | — | 129 | 134.5 | 171 | 2 | — | — | 2.08 |
| — | — | — | — | — | — | — | — | — | 131 | 146 | 204 | 2 | — | — | 5.29 |
| — | — | — | — | — | — | — | — | — | 133 | 161 | 247 | 2.5 | — | — | 12.5 |
| N | NR | 3.30 | 1.9 | 161.80 | 0.6 | 0.5 | 171.5 | 1.7 | 136.5 | 138 | 158.5 | 1 | 173 | 4.7 | 0.758 |
| N | NR | 3.70 | 1.9 | 176.80 | 0.6 | 0.5 | 186.5 | 1.7 | 138 | 144 | 172 | 1.5 | 188 | 5.1 | 1.57 |
| — | — | — | — | — | — | — | — | — | 136.5 | — | 193.5 | 1 | — | — | 2.4 |
| N | NR | 5.69 | 3.5 | 193.65 | 0.6 | 0.5 | 212.9 | 3.1 | 139 | 148.5 | 191 | 2 | 215 | 8.4 | 3.26 |
| — | — | — | — | — | — | — | — | — | 143 | 157 | 217 | 2.5 | — | — | 5.96 |
| — | — | — | — | — | — | — | — | — | 146 | 175 | 264 | 3 | — | — | 15.2 |
| N | NR | 3.30 | 1.9 | 171.80 | 0.6 | 0.5 | 181.5 | 1.7 | 146.5 | 148.5 | 168.5 | 1 | 183 | 4.7 | 0.832 |
| N | NR | 3.70 | 1.9 | 186.80 | 0.6 | 0.5 | 196.5 | 1.7 | 148 | 153.5 | 182 | 1.5 | 198 | 5.1 | 1.67 |
| — | — | — | — | — | — | — | — | — | 146.5 | — | 203.5 | 1 | — | — | 2.84 |
| — | — | — | — | — | — | — | — | — | 149 | 158.5 | 201 | 2 | — | — | 3.48 |
| — | — | — | — | — | — | — | — | — | 153 | 171.5 | 237 | 2.5 | — | — | 7.68 |
| — | — | — | — | — | — | — | — | — | 156 | 187 | 284 | 3 | — | — | 18.5 |
| N | NR | 3.30 | 1.9 | 186.80 | 0.6 | 0.5 | 196.5 | 1.7 | 156.5 | 160 | 183.5 | 1 | 198 | 4.7 | 1.15 |
| — | — | — | — | — | — | — | — | — | 159 | 166 | 201 | 2 | — | — | 3.01 |
| — | — | — | — | — | — | — | — | — | 156.5 | — | 218.5 | 1 | — | — | 3.62 |
| — | — | — | — | — | — | — | — | — | 161 | 170 | 214 | 2 | — | — | 4.24 |
| — | — | — | — | — | — | — | — | — | 163 | 186 | 257 | 2.5 | — | — | 10 |
| — | — | — | — | — | — | — | — | — | 166 | 203 | 304 | 3 | — | — | 22.7 |

**Remarks**

1. When using bearings with rotating outer rings, contact NSK if they are sealed, shielded, or have snap rings.
2. Please consult NSK about the snap ring groove dimensions of sealed and shielded bearings when the diameter of dimension series 18 and 19 is 50 mm or more.
3. The bearings denoted by an asterisk(*) are NSKHPS Deep groove ball bearings.

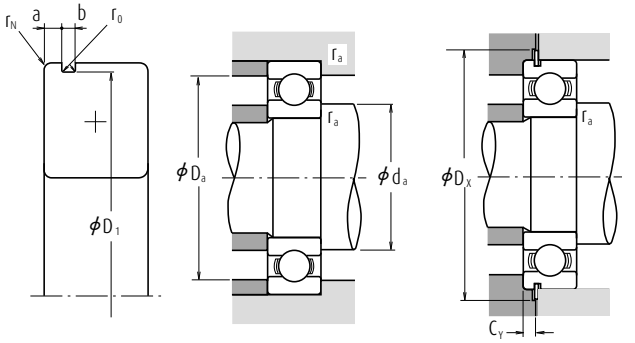
## Bore Diameter 160 mm




Open Type | Shielded Type ZZ · ZZS | Non-Contact Sealed Type VV | Contact Sealed Type DD · DDU | With Snap Ring Groove N | With Snap Ring NR

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Factor | Limiting Speeds (min$^{-1}$) | | | Bearing Numbers | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Grease | | Oil | | | | |
| d | D | B | r min. | $C_r$ | $C_{or}$ | $f_o$ | Open Z · ZZ V · VV | DU DDU | Open Z | Open | Shielded | Sealed | |
| **160** | 200 | 20 | 1.1 | 48 500 | 61 000 | 17.2 | 2 600 | 1 700 | 3 200 | **6832** | **ZZS** | **VV** | **DDU** |
| | 220 | 28 | 2 | 87 000 | 96 000 | 16.6 | 2 600 | 1 600 | 3 000 | **6932** | **ZZS** | — | **DDU** |
| | 240 | 25 | 1.5 | 99 000 | 108 000 | 16.5 | 2 400 | — | 2 800 | **16032** | — | — | — |
| | 240 | 38 | 2.1 | 137 000 | 135 000 | 15.9 | 2 400 | 1 600 | 2 800 | **6032** | **ZZ** | — | **DDU** |
| | 290 | 48 | 3 | 185 000 | 186 000 | 15.4 | 1 900 | — | 2 400 | **6232** | **ZZS** | — | — |
| | 340 | 68 | 4 | 278 000 | 287 000 | 13.9 | 1 700 | — | 2 000 | **6332** | **ZZS** | — | — |

**Notes** (1) For tolerances for the snap ring grooves and snap ring dimensions, refer to Pages **A116** to **A119.**
(2) When heavy axial loads are applied, increase $d_a$ and decrease $D_a$ from the above values.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $\frac{f_0F_a}{C_{or}}$ | e | $\frac{F_a}{F_r}\leq e$ | | $\frac{F_a}{F_r}>e$ | |
|---|---|---|---|---|---|
| | | X | Y | X | Y |
| 0.172 | 0.19 | 1 | 0 | 0.56 | 2.30 |
| 0.345 | 0.22 | 1 | 0 | 0.56 | 1.99 |
| 0.689 | 0.26 | 1 | 0 | 0.56 | 1.71 |
| 1.03 | 0.28 | 1 | 0 | 0.56 | 1.55 |
| 1.38 | 0.30 | 1 | 0 | 0.56 | 1.45 |
| 2.07 | 0.34 | 1 | 0 | 0.56 | 1.31 |
| 3.45 | 0.38 | 1 | 0 | 0.56 | 1.15 |
| 5.17 | 0.42 | 1 | 0 | 0.56 | 1.04 |
| 6.89 | 0.44 | 1 | 0 | 0.56 | 1.00 |

## Static Equivalent Load

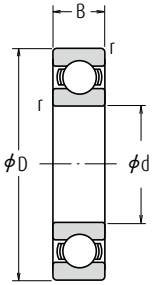
$\frac{F_a}{F_r}>0.8$, $P_0=0.6F_r+0.5F_a$

$\frac{F_a}{F_r}\leq 0.8$, $P_0=F_r$

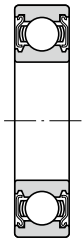
| With Snap Ring Groove | With Snap Ring | Snap Ring Groove Dimensions (1) (mm) | | | | | Snap Ring (1) Dimensions (mm) | | Abutment and Fillet Dimensions (mm) | | | | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | a max. | b min. | $D_1$ max. | $r_o$ max. | $r_N$ min. | $D_2$ max. | f max. | $d_a$(2) min. | $d_a$(2) max. | $D_a$(2) max. | $r_a$ max. | $D_x$ min. | $C_y$ max. | approx. |
| N | NR | 3.30 | 1.9 | 196.80 | 0.6 | 0.5 | 206.5 | 1.7 | 166.5 | 170.5 | 193.5 | 1 | 208 | 4.7 | 1.23 |
| — | — | — | — | — | — | — | — | — | 169 | 176 | 211 | 2 | — | — | 2.71 |
| — | — | — | — | — | — | — | — | — | 168 | — | 232 | 1.5 | — | — | 4.2 |
| — | — | — | — | — | — | — | — | — | 171 | 181.5 | 229 | 2 | — | — | 5.15 |
| — | — | — | — | — | — | — | — | — | 173 | 202 | 277 | 2.5 | — | — | 12.8 |
| — | — | — | — | — | — | — | — | — | 176 | 215.5 | 324 | 3 | — | — | 26.2 |

**Remarks**
1. When using bearings with rotating outer rings, contact NSK if they are sealed, shielded, or have snap rings.
2. Please consult NSK about the snap ring groove dimensions of sealed and shielded bearings when the diameter of dimension series 18 and 19 is 50 mm or more.

## Bore Diameter 170 – 240 mm



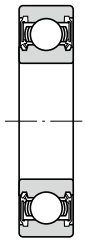

Open Type



Shielded Type
ZZS



Non-Contact
Sealed Type
VV

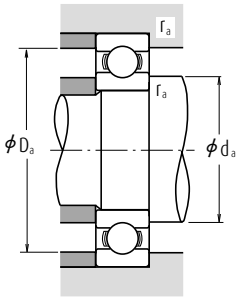


Contact
Sealed Type
DDU

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Factor | Limiting Speeds (min⁻¹) | | | Bearing Numbers | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Grease | | Oil | | | | |
| d | D | B | r min. | $C_r$ | $C_{0r}$ | $f_0$ | Open Z · ZZ V · VV | DU DDU | Open Z | Open | Shielded | Sealed | |
| **170** | 215 | 22 | 1.1 | 60 000 | 75 000 | 17.1 | 2 600 | 1 600 | 3 000 | **6834** | **ZZS** | **VV** | **DDU** |
| | 230 | 28 | 2 | 86 000 | 97 000 | 16.7 | 2 400 | — | 2 800 | **6934** | **ZZS** | — | — |
| | 260 | 28 | 1.5 | 114 000 | 126 000 | 16.5 | 2 200 | — | 2 600 | **16034** | — | — | — |
| | 260 | 42 | 2.1 | 161 000 | 161 000 | 15.8 | 2 200 | — | 2 600 | **6034** | **ZZS** | **VV** | — |
| | 310 | 52 | 4 | 212 000 | 224 000 | 15.3 | 1 800 | — | 2 200 | **6234** | **ZZS** | — | — |
| | 360 | 72 | 4 | 325 000 | 355 000 | 13.6 | 1 600 | — | 2 000 | **6334** | — | — | — |
| **180** | 225 | 22 | 1.1 | 60 500 | 78 500 | 17.2 | 2 400 | — | 2 800 | **6836** | — | **VV** | — |
| | 250 | 33 | 2 | 119 000 | 128 000 | 16.4 | 2 200 | — | 2 600 | **6936** | **ZZS** | — | — |
| | 280 | 31 | 2 | 145 000 | 157 000 | 16.3 | 2 000 | — | 2 400 | **16036** | — | — | — |
| | 280 | 46 | 2.1 | 180 000 | 185 000 | 15.6 | 2 000 | — | 2 400 | **6036** | **ZZS** | **VV** | — |
| | 320 | 52 | 4 | 227 000 | 241 000 | 15.1 | 1 700 | — | 2 000 | **6236** | **ZZS** | — | — |
| | 380 | 75 | 4 | 355 000 | 405 000 | 13.9 | 1 500 | — | 1 800 | **6336** | — | — | — |
| **190** | 240 | 24 | 1.5 | 73 000 | 93 500 | 17.1 | 2 200 | — | 2 600 | **6838** | — | **VV** | — |
| | 260 | 33 | 2 | 113 000 | 127 000 | 16.6 | 2 200 | — | 2 600 | **6938** | — | — | — |
| | 290 | 31 | 2 | 149 000 | 168 000 | 16.4 | 2 000 | — | 2 400 | **16038** | — | — | — |
| | 290 | 46 | 2.1 | 188 000 | 201 000 | 15.8 | 2 000 | — | 2 400 | **6038** | **ZZS** | — | — |
| | 340 | 55 | 4 | 255 000 | 282 000 | 15.0 | 1 600 | — | 2 000 | **6238** | **ZZS** | — | — |
| | 400 | 78 | 5 | 355 000 | 415 000 | 14.1 | 1 400 | — | 1 700 | **6338** | — | — | — |
| **200** | 250 | 24 | 1.5 | 74 000 | 98 000 | 17.2 | 2 200 | — | 2 600 | **6840** | — | — | — |
| | 280 | 38 | 2.1 | 143 000 | 158 000 | 16.4 | 2 000 | — | 2 400 | **6940** | **ZZS** | — | — |
| | 310 | 34 | 2 | 161 000 | 180 000 | 16.4 | 1 900 | — | 2 200 | **16040** | — | — | — |
| | 310 | 51 | 2.1 | 207 000 | 226 000 | 15.6 | 1 900 | — | 2 200 | **6040** | **ZZS** | — | — |
| | 360 | 58 | 4 | 269 000 | 310 000 | 15.2 | 1 500 | — | 1 800 | **6240** | **ZZS** | — | — |
| | 420 | 80 | 5 | 380 000 | 445 000 | 13.8 | 1 300 | — | 1 600 | **6340** | — | — | — |
| **220** | 270 | 24 | 1.5 | 76 500 | 107 000 | 17.4 | 1 900 | — | 2 400 | **6844** | **ZZS** | — | — |
| | 300 | 38 | 2.1 | 146 000 | 169 000 | 16.6 | 1 800 | — | 2 200 | **6944** | **ZZS** | — | — |
| | 340 | 37 | 2.1 | 180 000 | 217 000 | 16.5 | 1 600 | — | 2 000 | **16044** | — | — | — |
| | 340 | 56 | 3 | 235 000 | 271 000 | 15.6 | 1 700 | — | 2 000 | **6044** | **ZZS** | — | — |
| | 400 | 65 | 4 | 310 000 | 375 000 | 15.1 | 1 300 | — | 1 600 | **6244** | — | — | — |
| | 460 | 88 | 5 | 410 000 | 520 000 | 14.3 | 1 200 | — | 1 500 | **6344** | — | — | — |
| **240** | 300 | 28 | 2 | 98 500 | 137 000 | 17.3 | 1 700 | — | 2 000 | **6848** | — | — | — |
| | 320 | 38 | 2.1 | 154 000 | 190 000 | 16.8 | 1 700 | — | 2 000 | **6948** | **ZZS** | — | — |
| | 360 | 37 | 2.1 | 196 000 | 243 000 | 16.5 | 1 500 | — | 1 900 | **16048** | — | — | — |
| | 360 | 56 | 3 | 244 000 | 296 000 | 15.9 | 1 500 | — | 1 900 | **6048** | — | — | — |
| | 440 | 72 | 4 | 340 000 | 430 000 | 15.2 | 1 200 | — | 1 500 | **6248** | — | — | — |
| | 500 | 95 | 5 | 470 000 | 625 000 | 14.2 | 1 100 | — | 1 300 | **6348** | — | — | — |

**Note** (1) When heavy axial loads are applied, increase $d_a$ and decrease $D_a$ from the above values.

**Remark** When using bearings with rotating outer rings, contact NSK if they are sealed or shielded.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $\frac{f_o F_a}{C_{or}}$ | e | $\frac{F_a}{F_r} \leq e$ | | $\frac{F_a}{F_r} > e$ | |
|---|---|---|---|---|---|
| | | X | Y | X | Y |
| 0.172 | 0.19 | 1 | 0 | 0.56 | 2.30 |
| 0.345 | 0.22 | 1 | 0 | 0.56 | 1.99 |
| 0.689 | 0.26 | 1 | 0 | 0.56 | 1.71 |
| 1.03 | 0.28 | 1 | 0 | 0.56 | 1.55 |
| 1.38 | 0.30 | 1 | 0 | 0.56 | 1.45 |
| 2.07 | 0.34 | 1 | 0 | 0.56 | 1.31 |
| 3.45 | 0.38 | 1 | 0 | 0.56 | 1.15 |
| 5.17 | 0.42 | 1 | 0 | 0.56 | 1.04 |
| 6.89 | 0.44 | 1 | 0 | 0.56 | 1.00 |

## Static Equivalent Load

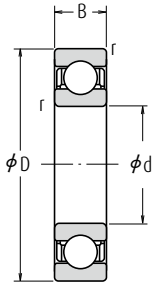
$\frac{F_a}{F_r} > 0.8$, $P_0=0.6F_r+0.5F_a$

$\frac{F_a}{F_r} \leq 0.8$, $P_0=F_r$

| Abutment and Fillet Dimensions (mm) | | | | Mass (kg) |
|---|---|---|---|---|
| $d_a$(1) min. | $d_a$(1) max. | $D_a$(1) max. | $r_a$ max. | approx. |
| 176.5 | 182.0 | 208.5 | 1 | 1.86 |
| 179 | 186.0 | 221 | 2 | 3.34 |
| 178 | — | 252 | 1.5 | 5.71 |
| 181 | 194.5 | 249 | 2 | 6.89 |
| 186 | 215.0 | 294 | 3 | 15.8 |
| 186 | — | 344 | 3 | 36.6 |
| 186.5 | 192.0 | 218.5 | 1 | 1.98 |
| 189 | 198.5 | 241 | 2 | 4.16 |
| 189 | — | 271 | 2 | 7.5 |
| 191 | 208.0 | 269 | 2 | 8.88 |
| 196 | 223.0 | 304 | 3 | 15.9 |
| 196 | — | 364 | 3 | 43.1 |
| 198 | 202.5 | 232 | 1.5 | 2.53 |
| 199 | — | 251 | 2 | 5.18 |
| 199 | — | 281 | 2 | 7.78 |
| 201 | 218.0 | 279 | 2 | 9.39 |
| 206 | 236.0 | 324 | 3 | 22.3 |
| 210 | — | 380 | 4 | 49.7 |
| 208 | — | 242 | 1.5 | 2.67 |
| 211 | 222.0 | 269 | 2 | 7.28 |
| 209 | — | 301 | 2 | 10 |
| 211 | 231.5 | 299 | 2 | 12 |
| 216 | 252.0 | 344 | 3 | 26.7 |
| 220 | — | 400 | 4 | 55.3 |
| 228 | 233.5 | 262 | 1.5 | 2.9 |
| 231 | 242.0 | 289 | 2 | 7.88 |
| 231 | — | 329 | 2 | 13.1 |
| 233 | 254.5 | 327 | 2.5 | 18.6 |
| 236 | — | 384 | 3 | 37.4 |
| 240 | — | 440 | 4 | 73.9 |
| 249 | — | 291 | 2 | 4.48 |
| 251 | 262.0 | 309 | 2 | 8.49 |
| 251 | — | 349 | 2 | 13.9 |
| 253 | — | 347 | 2.5 | 19.9 |
| 256 | — | 424 | 3 | 50.5 |
| 260 | — | 480 | 4 | 94.4 |

# Single-Row Deep Groove Ball Bearings

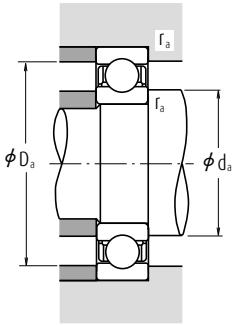
## Bore Diameter 260 – 360 mm




Open Type

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Factor | Limiting Speeds ($min^{-1}$) | | Bearing Numbers |
|---|---|---|---|---|---|---|---|---|---|
| d | D | B | r min. | $C_r$ | $C_{0r}$ | $f_0$ | Grease | Oil | Open |
| **260** | 320 | 28 | 2 | 101 000 | 148 000 | 17.4 | 1 600 | 1 900 | **6852** |
| | 360 | 46 | 2.1 | 204 000 | 255 000 | 16.5 | 1 500 | 1 800 | **6952** |
| | 400 | 44 | 3 | 237 000 | 310 000 | 16.4 | 1 400 | 1 700 | **16052** |
| | 400 | 65 | 4 | 291 000 | 375 000 | 15.8 | 1 400 | 1 700 | **6052** |
| | 480 | 80 | 5 | 400 000 | 540 000 | 15.1 | 1 100 | 1 300 | **6252** |
| | 540 | 102 | 6 | 505 000 | 710 000 | 14.6 | 1 000 | 1 200 | **6352** |
| **280** | 350 | 33 | 2 | 133 000 | 191 000 | 17.3 | 1 500 | 1 700 | **6856** |
| | 380 | 46 | 2.1 | 209 000 | 272 000 | 16.6 | 1 400 | 1 700 | **6956** |
| | 420 | 44 | 3 | 243 000 | 330 000 | 16.5 | 1 300 | 1 600 | **16056** |
| | 420 | 65 | 4 | 300 000 | 410 000 | 16.0 | 1 300 | 1 600 | **6056** |
| | 500 | 80 | 5 | 400 000 | 550 000 | 15.2 | 1 000 | 1 300 | **6256** |
| | 580 | 108 | 6 | 570 000 | 840 000 | 14.5 | 900 | 1 100 | **6356** |
| **300** | 380 | 38 | 2.1 | 166 000 | 233 000 | 17.1 | 1 300 | 1 600 | **6860** |
| | 420 | 56 | 3 | 269 000 | 370 000 | 16.4 | 1 300 | 1 500 | **6960** |
| | 460 | 50 | 4 | 285 000 | 405 000 | 16.4 | 1 200 | 1 400 | **16060** |
| | 460 | 74 | 4 | 355 000 | 500 000 | 15.8 | 1 200 | 1 400 | **6060** |
| | 540 | 85 | 5 | 465 000 | 670 000 | 15.1 | 950 | 1 200 | **6260** |
| **320** | 400 | 38 | 2.1 | 168 000 | 244 000 | 17.2 | 1 300 | 1 500 | **6864** |
| | 440 | 56 | 3 | 266 000 | 375 000 | 16.5 | 1 200 | 1 400 | **6964** |
| | 480 | 50 | 4 | 293 000 | 430 000 | 16.5 | 1 100 | 1 300 | **16064** |
| | 480 | 74 | 4 | 390 000 | 570 000 | 15.7 | 1 100 | 1 300 | **6064** |
| | 580 | 92 | 5 | 530 000 | 805 000 | 15.0 | 850 | 1 100 | **6264** |
| **340** | 420 | 38 | 2.1 | 175 000 | 265 000 | 17.3 | 1 200 | 1 400 | **6868** |
| | 460 | 56 | 3 | 273 000 | 400 000 | 16.6 | 1 100 | 1 300 | **6968** |
| | 520 | 82 | 5 | 440 000 | 660 000 | 15.6 | 1 000 | 1 200 | **6068** |
| | 620 | 92 | 6 | 530 000 | 820 000 | 15.3 | 800 | 1 000 | **6268** |
| **360** | 440 | 38 | 2.1 | 192 000 | 290 000 | 17.3 | 1 100 | 1 300 | **6872** |
| | 480 | 56 | 3 | 280 000 | 425 000 | 16.7 | 1 100 | 1 300 | **6972** |
| | 540 | 82 | 5 | 460 000 | 720 000 | 15.7 | 950 | 1 200 | **6072** |
| | 650 | 95 | 6 | 555 000 | 905 000 | 15.4 | 750 | 950 | **6272** |

**Note** (1) When heavy axial loads are applied. increase $d_a$ and decrease $D_a$ from the above values.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $\frac{f_o F_a}{C_{or}}$ | e | $\frac{F_a}{F_r} \leq e$ | | $\frac{F_a}{F_r} > e$ | |
|---|---|---|---|---|---|
| | | X | Y | X | Y |
| 0.172 | 0.19 | 1 | 0 | 0.56 | 2.30 |
| 0.345 | 0.22 | 1 | 0 | 0.56 | 1.99 |
| 0.689 | 0.26 | 1 | 0 | 0.56 | 1.71 |
| 1.03 | 0.28 | 1 | 0 | 0.56 | 1.55 |
| 1.38 | 0.30 | 1 | 0 | 0.56 | 1.45 |
| 2.07 | 0.34 | 1 | 0 | 0.56 | 1.31 |
| 3.45 | 0.38 | 1 | 0 | 0.56 | 1.15 |
| 5.17 | 0.42 | 1 | 0 | 0.56 | 1.04 |
| 6.89 | 0.44 | 1 | 0 | 0.56 | 1.00 |

## Static Equivalent Load

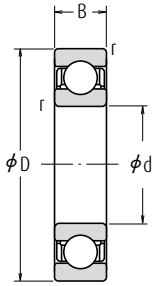
$\frac{F_a}{F_r} > 0.8$, $P_0=0.6F_r+0.5F_a$

$\frac{F_a}{F_r} \leq 0.8$, $P_0=F_r$

| Abutment and Fillet Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|
| $d_a$(1) min. | $D_a$(1) max. | $r_a$ max. | approx. |
| 269 | 311 | 2 | 4.84 |
| 271 | 349 | 2 | 14 |
| 273 | 387 | 2.5 | 21.1 |
| 276 | 384 | 3 | 29.4 |
| 280 | 460 | 4 | 67 |
| 286 | 514 | 5 | 118 |
| 289 | 341 | 2 | 7.2 |
| 291 | 369 | 2 | 15.1 |
| 293 | 407 | 2.5 | 22.7 |
| 296 | 404 | 3 | 31.2 |
| 300 | 480 | 4 | 70.4 |
| 306 | 554 | 5 | 144 |
| 311 | 369 | 2 | 10.3 |
| 313 | 407 | 2.5 | 23.9 |
| 316 | 444 | 3 | 31.5 |
| 316 | 444 | 3 | 44.2 |
| 320 | 520 | 4 | 87.8 |
| 331 | 389 | 2 | 10.8 |
| 333 | 427 | 2.5 | 25.3 |
| 336 | 464 | 3 | 33.2 |
| 336 | 464 | 3 | 46.5 |
| 340 | 560 | 4 | 111 |
| 351 | 409 | 2 | 11.5 |
| 353 | 447 | 2.5 | 26.6 |
| 360 | 500 | 4 | 62.3 |
| 366 | 594 | 5 | 129 |
| 371 | 429 | 2 | 11.8 |
| 373 | 467 | 2.5 | 27.9 |
| 380 | 520 | 4 | 65.3 |
| 386 | 624 | 5 | 145 |

# Single-Row Deep Groove Ball Bearings

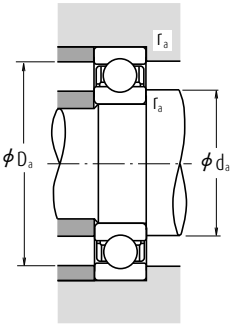
## Bore Diameter 380 – 600 mm




Open Type

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Factor | Limiting Speeds ($min^{-1}$) | | Bearing Numbers |
|---|---|---|---|---|---|---|---|---|---|
| d | D | B | r min. | $C_r$ | $C_{0r}$ | $f_0$ | Grease | Oil | Open |
| **380** | 480 | 46 | 2.1 | 238 000 | 375 000 | 17.1 | 1 000 | 1 200 | **6876** |
| | 520 | 65 | 4 | 325 000 | 510 000 | 16.6 | 950 | 1 200 | **6976** |
| | 560 | 82 | 5 | 455 000 | 725 000 | 15.9 | 900 | 1 100 | **6076** |
| **400** | 500 | 46 | 2.1 | 241 000 | 390 000 | 17.2 | 950 | 1 200 | **6880** |
| | 540 | 65 | 4 | 335 000 | 540 000 | 16.7 | 900 | 1 100 | **6980** |
| | 600 | 90 | 5 | 510 000 | 825 000 | 15.7 | 850 | 1 000 | **6080** |
| **420** | 520 | 46 | 2.1 | 245 000 | 410 000 | 17.3 | 900 | 1 100 | **6884** |
| | 560 | 65 | 4 | 340 000 | 570 000 | 16.8 | 900 | 1 100 | **6984** |
| | 620 | 90 | 5 | 530 000 | 895 000 | 15.8 | 800 | 1 000 | **6084** |
| **440** | 540 | 46 | 2.1 | 248 000 | 425 000 | 17.4 | 900 | 1 100 | **6888** |
| | 600 | 74 | 4 | 395 000 | 680 000 | 16.6 | 800 | 1 000 | **6988** |
| | 650 | 94 | 6 | 550 000 | 965 000 | 16.0 | 750 | 900 | **6088** |
| **460** | 580 | 56 | 3 | 310 000 | 550 000 | 17.1 | 800 | 1 000 | **6892** |
| | 620 | 74 | 4 | 405 000 | 720 000 | 16.7 | 800 | 950 | **6992** |
| | 680 | 100 | 6 | 605 000 | 1 080 000 | 15.8 | 710 | 850 | **6092** |
| **480** | 600 | 56 | 3 | 315 000 | 575 000 | 17.2 | 800 | 950 | **6896** |
| | 650 | 78 | 5 | 450 000 | 815 000 | 16.6 | 750 | 900 | **6996** |
| | 700 | 100 | 6 | 605 000 | 1 090 000 | 15.9 | 710 | 850 | **6096** |
| **500** | 620 | 56 | 3 | 320 000 | 600 000 | 17.3 | 750 | 900 | **68/500** |
| | 670 | 78 | 5 | 460 000 | 865 000 | 16.7 | 710 | 850 | **69/500** |
| | 720 | 100 | 6 | 630 000 | 1 170 000 | 16.0 | 670 | 800 | **60/500** |
| **530** | 650 | 56 | 3 | 325 000 | 625 000 | 17.4 | 710 | 850 | **68/530** |
| | 710 | 82 | 5 | 455 000 | 870 000 | 16.8 | 670 | 800 | **69/530** |
| | 780 | 112 | 6 | 680 000 | 1 300 000 | 16.0 | 600 | 750 | **60/530** |
| **560** | 680 | 56 | 3 | 330 000 | 650 000 | 17.4 | 670 | 800 | **68/560** |
| | 750 | 85 | 5 | 525 000 | 1 040 000 | 16.7 | 600 | 750 | **69/560** |
| | 820 | 115 | 6 | 735 000 | 1 500 000 | 16.2 | 560 | 670 | **60/560** |
| **600** | 730 | 60 | 3 | 355 000 | 735 000 | 17.5 | 600 | 710 | **68/600** |
| | 800 | 90 | 5 | 550 000 | 1 160 000 | 16.9 | 560 | 670 | **69/600** |
| | 870 | 118 | 6 | 790 000 | 1 640 000 | 16.1 | 530 | 630 | **60/600** |

**Note** (1) When heavy axial loads are applied. increase $d_a$ and decrease $D_a$ from the above values.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $\frac{f_o F_a}{C_{or}}$ | e | $\frac{F_a}{F_r} \leq e$ | | $\frac{F_a}{F_r} > e$ | |
|---|---|---|---|---|---|
| | | X | Y | X | Y |
| 0.172 | 0.19 | 1 | 0 | 0.56 | 2.30 |
| 0.345 | 0.22 | 1 | 0 | 0.56 | 1.99 |
| 0.689 | 0.26 | 1 | 0 | 0.56 | 1.71 |
| 1.03 | 0.28 | 1 | 0 | 0.56 | 1.55 |
| 1.38 | 0.30 | 1 | 0 | 0.56 | 1.45 |
| 2.07 | 0.34 | 1 | 0 | 0.56 | 1.31 |
| 3.45 | 0.38 | 1 | 0 | 0.56 | 1.15 |
| 5.17 | 0.42 | 1 | 0 | 0.56 | 1.04 |
| 6.89 | 0.44 | 1 | 0 | 0.56 | 1.00 |

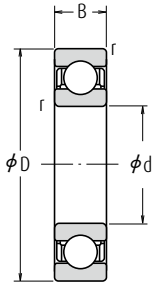
## Static Equivalent Load

$\frac{F_a}{F_r} > 0.8$, $P_0=0.6F_r+0.5F_a$

$\frac{F_a}{F_r} \leq 0.8$, $P_0=F_r$

| Abutment and Fillet Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|
| $d_a$(1) min. | $D_a$(1) max. | $r_a$ max. | approx. |
| 391 | 469 | 2 | 19.5 |
| 396 | 504 | 3 | 40 |
| 400 | 540 | 4 | 68 |
| 411 | 489 | 2 | 20.5 |
| 416 | 524 | 3 | 42 |
| 420 | 580 | 4 | 88.4 |
| 431 | 509 | 2 | 21.4 |
| 436 | 544 | 3 | 43.6 |
| 440 | 600 | 4 | 92.2 |
| 451 | 529 | 2 | 22.3 |
| 456 | 584 | 3 | 60.2 |
| 466 | 624 | 5 | 106 |
| 473 | 567 | 2.5 | 34.3 |
| 476 | 604 | 3 | 62.6 |
| 486 | 654 | 5 | 123 |
| 493 | 587 | 2.5 | 35.4 |
| 500 | 630 | 4 | 73.5 |
| 506 | 674 | 5 | 127 |
| 513 | 607 | 2.5 | 37.2 |
| 520 | 650 | 4 | 82 |
| 526 | 694 | 5 | 131 |
| 543 | 637 | 2.5 | 39.8 |
| 550 | 690 | 4 | 89.8 |
| 556 | 754 | 5 | 184 |
| 573 | 667 | 2.5 | 41.5 |
| 580 | 730 | 4 | 105 |
| 586 | 793.5 | 5 | 203 |
| 613 | 717 | 2.5 | 50.9 |
| 620 | 780 | 4 | 120 |
| 626 | 844 | 5 | 236 |

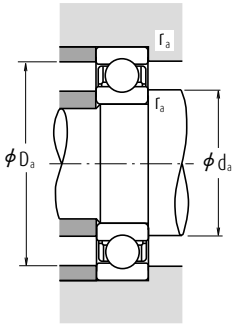
## Bore Diameter 630 – 800 mm




Open Type

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Factor | Limiting Speeds ($min^{-1}$) | | Bearing Numbers |
|---|---|---|---|---|---|---|---|---|---|
| d | D | B | r min. | $C_r$ | $C_{0r}$ | $f_0$ | Grease | Oil | Open |
| **630** | 780 | 69 | 4 | 420 000 | 890 000 | 17.3 | 560 | 670 | **68/630** |
| | 850 | 100 | 6 | 625 000 | 1 350 000 | 16.7 | 530 | 630 | **69/630** |
| | 920 | 128 | 7.5 | 750 000 | 1 620 000 | 16.4 | 480 | 600 | **60/630** |
| **670** | 820 | 69 | 4 | 435 000 | 965 000 | 17.4 | 500 | 630 | **68/670** |
| | 900 | 103 | 6 | 675 000 | 1 460 000 | 16.7 | 480 | 560 | **69/670** |
| | 980 | 136 | 7.5 | 765 000 | 1 730 000 | 16.6 | 450 | 530 | **60/670** |
| **710** | 870 | 74 | 4 | 480 000 | 1 100 000 | 17.4 | 480 | 560 | **68/710** |
| | 950 | 106 | 6 | 715 000 | 1 640 000 | 16.8 | 450 | 530 | **69/710** |
| **750** | 920 | 78 | 5 | 525 000 | 1 260 000 | 17.4 | 430 | 530 | **68/750** |
| | 1 000 | 112 | 6 | 785 000 | 1 840 000 | 16.7 | 400 | 500 | **69/750** |
| **800** | 980 | 82 | 5 | 530 000 | 1 310 000 | 17.5 | 400 | 480 | **68/800** |
| | 1 060 | 115 | 6 | 825 000 | 2 050 000 | 16.8 | 380 | 450 | **69/800** |

**Note** (1) When heavy axial loads are applied. increase $d_a$ and decrease $D_a$ from the above values.




| Abutment and Fillet Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|
| $d_a$(1) min. | $D_a$(1) max. | $r_a$ max. | approx. |
| 646 | 764 | 3 | 71.3 |
| 656 | 824 | 5 | 163 |
| 662 | 888 | 6 | 285 |
| 686 | 804 | 3 | 75.4 |
| 696 | 874 | 5 | 181 |
| 702 | 948 | 6 | 351 |
| 726 | 854 | 3 | 92.6 |
| 736 | 924 | 5 | 208 |
| 770 | 900 | 4 | 110 |
| 776 | 974 | 5 | 245 |
| 820 | 960 | 4 | 132 |
| 826 | 1034 | 5 | 275 |

## Dynamic Equivalent Load $P=XF_r+YF_a$

| $\frac{f_oF_a}{C_{or}}$ | e | $\frac{F_a}{F_r}\leq e$ | | $\frac{F_a}{F_r}>e$ | |
|---|---|---|---|---|---|
| | | X | Y | X | Y |
| 0.172 | 0.19 | 1 | 0 | 0.56 | 2.30 |
| 0.345 | 0.22 | 1 | 0 | 0.56 | 1.99 |
| 0.689 | 0.26 | 1 | 0 | 0.56 | 1.71 |
| 1.03 | 0.28 | 1 | 0 | 0.56 | 1.55 |
| 1.38 | 0.30 | 1 | 0 | 0.56 | 1.45 |
| 2.07 | 0.34 | 1 | 0 | 0.56 | 1.31 |
| 3.45 | 0.38 | 1 | 0 | 0.56 | 1.15 |
| 5.17 | 0.42 | 1 | 0 | 0.56 | 1.04 |
| 6.89 | 0.44 | 1 | 0 | 0.56 | 1.00 |

## Static Equivalent Load

$\frac{F_a}{F_r}>0.8$, $P_0=0.6F_r+0.5F_a$

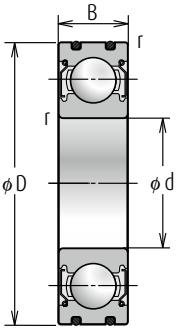
$\frac{F_a}{F_r}\leq 0.8$, $P_0=F_r$

## Bore Diameter 10 – 100 mm

| Bearing bore diameter d (mm) | Bearing outer diameter D (mm) | Bearing width B (mm) | Basic load ratings | | Recommended fits (1) |
|---|---|---|---|---|---|
| | | | $C_r$(N) | $C_{0r}$(N) | |
| 10 | 26 | 8 | 4 550 | 1 970 | H7 or G6 |
| | 30 | 9 | 5 100 | 2 390 | |
| | 35 | 11 | 8 100 | 3 450 | |
| 12 | 28 | 8 | 5 100 | 2 370 | |
| | 32 | 10 | 6 800 | 3 050 | |
| | 37 | 12 | 9 700 | 4 200 | |
| 15 | 32 | 9 | 5 600 | 2 830 | |
| | 35 | 11 | 7 650 | 3 750 | |
| | 42 | 13 | 11 400 | 5 450 | |
| 17 | 35 | 10 | 6 000 | 3 250 | |
| | 40 | 12 | 9 550 | 4 800 | |
| | 47 | 14 | 13 600 | 6 650 | |
| 20 | 42 | 12 | 9 400 | 5 000 | |
| | 47 | 14 | 12 800 | 6 600 | |
| | 52 | 15 | 15 900 | 7 900 | |
| 25 | 47 | 12 | 10 100 | 5 850 | |
| | 52 | 15 | 14 000 | 7 850 | |
| | 62 | 17 | 20 600 | 11 200 | |
| 30 | 55 | 13 | 13 200 | 8 300 | |
| | 62 | 16 | 19 500 | 11 300 | |
| | 72 | 19 | 26 700 | 15 000 | |
| 35 | 62 | 14 | 16 000 | 10 300 | |
| | 72 | 17 | 25 700 | 15 300 | |
| | 80 | 21 | 33 500 | 19 200 | |
| 40 | 68 | 15 | 16 800 | 11 500 | |
| | 80 | 18 | 29 100 | 17 900 | |
| | 90 | 23 | 40 500 | 24 000 | |
| 45 | 75 | 16 | 20 900 | 15 200 | |
| | 85 | 19 | 31 500 | 20 400 | |
| | 100 | 25 | 53 000 | 32 000 | |
| 50 | 80 | 16 | 21 800 | 16 600 | |
| | 90 | 20 | 35 000 | 23 200 | |
| | 110 | 27 | 62 000 | 38 500 | |
| 55 | 90 | 18 | 28 300 | 21 200 | |
| | 100 | 21 | 43 500 | 29 300 | |
| | 120 | 29 | 71 500 | 44 500 | |
| 60 | 95 | 18 | 29 500 | 23 200 | |
| | 110 | 22 | 52 500 | 36 000 | |
| | 130 | 31 | 82 000 | 52 000 | |
| 65 | 100 | 18 | 30 500 | 25 200 | |
| | 120 | 23 | 57 500 | 40 000 | |
| | 140 | 33 | 92 500 | 60 000 | |
| 70 | 110 | 20 | 38 000 | 31 000 | |
| | 125 | 24 | 62 000 | 44 000 | |
| | 150 | 35 | 104 000 | 68 000 | |
| 75 | 115 | 20 | 39 500 | 33 500 | |
| | 130 | 25 | 66 000 | 49 500 | |
| 80 | 125 | 22 | 47 500 | 40 000 | |
| | 140 | 26 | 72 500 | 53 000 | |
| 85 | 130 | 22 | 49 500 | 43 000 | |
| | 150 | 28 | 84 000 | 62 000 | |
| 90 | 140 | 24 | 58 000 | 50 000 | |
| 95 | 145 | 24 | 60 500 | 54 000 | |
| 100 | 150 | 24 | 60 000 | 54 000 | |

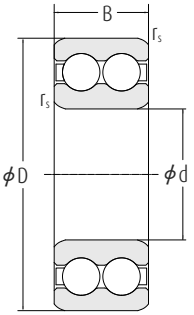
**Notes** (1) Although recommended fits are H7 or G6. G6 is recommended when used under conditions that prioritize insertion under light preload.
(2) Low-contact seal available for seal type bearings. Contact NSK for details.

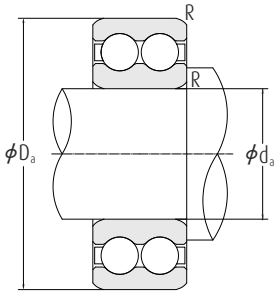
| Bearing number | | | |
|---|---|---|---|
| Basic number(Open type) | Shield type | Contact seal type (2) | Non-contact seal type |
| 6000<br>6200<br>6300 | ZZ | DDU | VV |
| 6001<br>6201<br>6301 | ZZ | DDU | VV |
| 6002<br>6202<br>6302 | ZZ | DDU | VV |
| 6003<br>6203<br>6303 | ZZ | DDU | VV |
| 6004<br>6204<br>6304 | ZZ | DDU | VV |
| 6005<br>6205<br>6305 | ZZ | DDU | VV |
| 6006<br>6206<br>6306 | ZZ | DDU | VV |
| 6007<br>6207<br>6307 | ZZ | DDU | VV |
| 6008<br>6208<br>6308 | ZZ | DDU | VV |
| 6009<br>6209<br>6309 | ZZ | DDU | VV |
| 6010<br>6210<br>6310 | ZZ | DDU | VV |
| 6011<br>6211<br>6311 | ZZ | DDU | VV |
| 6012<br>6212<br>6312 | ZZ | DDU | VV |
| 6013<br>6213<br>6313 | ZZ | DDU | VV |
| 6014<br>6214<br>6314 | ZZ | DDU | VV |
| 6015<br>6215 | ZZ | DDU | VV |
| 6016<br>6216 | ZZ | DDU | VV |
| 6017<br>6217 | ZZ | DDU | VV |
| 6018 | ZZ | DDU | VV |
| 6019 | ZZ | DDU | VV |
| 6020 | ZZ | DDU | VV |



# Deep Groove Ball Bearings

## Double Row | Bore 10 - 90 mm



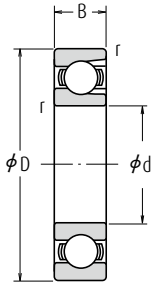




| Dimensions | | | | Abbreviation | Load ratings | |
|---|---|---|---|---|---|---|
| d | D | B | $r_s$ min | | dyn. C | stat. $C_o$ |
| | mm | | | | kN | |
| **10** | 30 | 14 | 0.6 | 4200BTNG | 9.15 | 5.2 |
| **12** | 32 | 14 | 0.6 | 4201BTNG | 9.30 | 5.5 |
| **15** | 35 | 14 | 0.6 | 4202BTNG | 10.4 | 6.7 |
| | 42 | 17 | 1.0 | 4302BTNG | 14.6 | 9.2 |
| **17** | 40 | 16 | 0.6 | 4203BTNG | 14.6 | 9.5 |
| | 47 | 19 | 1.0 | 4303BTNG | 19.6 | 13.2 |
| **20** | 47 | 18 | 1.0 | 4204BTNG | 18.0 | 12.7 |
| | 52 | 21 | 1,1 | 4304BTNG | 23.2 | 16.0 |
| **25** | 52 | 18 | 1.0 | 4205BTNG | 19.3 | 14.6 |
| | 62 | 24 | 1.1 | 4305BTNG | 31.5 | 22.4 |
| **30** | 62 | 20 | 1.0 | 4206BTNG | 26.0 | 20.8 |
| | 72 | 27 | 1.1 | 4306BTNG | 40.0 | 30.5 |
| **35** | 72 | 23 | 1.1 | 4207BTNG | 32.0 | 26.0 |
| | 80 | 31 | 1.5 | 4307BTNG | 51.0 | 38.0 |
| **40** | 80 | 23 | 1.1 | 4208BTNG | 34.0 | 30.0 |
| | 90 | 33 | 1.5 | 4308BTNG | 63.0 | 48.0 |
| **45** | 85 | 23 | 1.1 | 4209BTNG | 36.0 | 33.5 |
| | 100 | 36 | 1.5 | 4309BTNG | 72.0 | 60.0 |
| **50** | 90 | 23 | 1.1 | 4210BTNG | 37.5 | 36.5 |
| | 110 | 40 | 2.0 | 4310BTNG | 90.0 | 75.0 |
| **55** | 100 | 25 | 1.5 | 4211BTNG | 43.0 | 43.0 |
| | 120 | 43 | 2.0 | 4311BTNG | 104.0 | 90.0 |
| **60** | 110 | 28 | 1.5 | 4212BTNG | 57.0 | 58.5 |
| | 130 | 46 | 2.1 | 4312BTNG | 120.0 | 106.0 |
| **65** | 120 | 31 | 1.5 | 4213BTNG | 67.0 | 67.0 |
| | 140 | 48 | 2.1 | 4313BTNG | 129.0 | 98.0 |
| **70** | 125 | 31 | 1.5 | 4214BTNG | 69.5 | 73.5 |
| | 150 | 51 | 2.1 | 4314BTNG | 146.0 | 114.0 |
| **75** | 130 | 31 | 1.5 | 4215BTNG | 73.5 | 80.0 |
| | 160 | 55 | 2.1 | 4315BTNG | 170.0 | 134.0 |
| **80** | 140 | 33 | 2.0 | 4216BTNG | 80.0 | 90.0 |
| **85** | 150 | 36 | 2.0 | 4217BTNG | 93.0 | 106.0 |
| **90** | 160 | 40 | 2.0 | 4218BTNG | 112.0 | 122.0 |

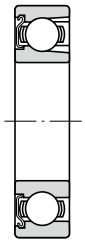
| Speed limits | | Abutment dimensions | | | Weight |
|---|---|---|---|---|---|
| Grease | Oil | $d_a$ min | $D_a$ max | R min | |
| min$^{-1}$ | | | | | kg |
| 18 000 | 24 000 | 14.0 | 26.0 | 0.6 | 0.049 |
| 16 000 | 20 000 | 16.0 | 28.0 | 0.6 | 0.053 |
| 14 000 | 18 000 | 19.0 | 31.0 | 0.6 | 0.059 |
| 13 000 | 17 000 | 20.0 | 37.0 | 1.0 | 0.120 |
| 13 000 | 18 000 | 21.0 | 36.0 | 1.0 | 0.090 |
| 11 000 | 17 000 | 22.0 | 42.0 | 1.0 | 0.160 |
| 10 000 | 14 000 | 25.0 | 42.0 | 1.0 | 0.140 |
| 9 500 | 13 000 | 26.5 | 45.5 | 1.0 | 0.210 |
| 9 000 | 12 000 | 30.0 | 47.0 | 1.0 | 0.160 |
| 8 000 | 10 000 | 31.5 | 55.5 | 1.0 | 0.340 |
| 7 500 | 9 500 | 35.0 | 57.0 | 1.0 | 0.260 |
| 6 700 | 8 500 | 36.5 | 65.5 | 1.0 | 0.500 |
| 6 700 | 8 500 | 41.5 | 65.5 | 1.0 | 0.400 |
| 6 300 | 8 000 | 43.0 | 72.0 | 1.5 | 0.690 |
| 6 000 | 7 500 | 46.5 | 73.5 | 1.0 | 0.500 |
| 5 600 | 7 000 | 48.0 | 82.0 | 1.5 | 0.950 |
| 5 600 | 7 000 | 51.5 | 78.5 | 1.0 | 0.540 |
| 4 800 | 6 000 | 53.0 | 92.0 | 1.5 | 1.250 |
| 5 000 | 6 300 | 56.5 | 83.5 | 1.0 | 0.580 |
| 4 300 | 5 300 | 59.0 | 101.0 | 2.0 | 1.700 |
| 4 500 | 5 600 | 63.0 | 92.0 | 1.5 | 0.800 |
| 4 000 | 5 000 | 64.0 | 111.0 | 2.0 | 2.150 |
| 4 000 | 5 000 | 68.0 | 102.0 | 1.5 | 1.100 |
| 3 600 | 4 500 | 71.0 | 119.0 | 2.0 | 2.650 |
| 3 800 | 4 800 | 73.0 | 112.0 | 1.5 | 1.450 |
| 3 600 | 4 500 | 76.0 | 129.0 | 2.0 | 3.250 |
| 3 600 | 4 500 | 78.0 | 117.0 | 1.5 | 1.500 |
| 3 200 | 4 000 | 81.0 | 139.0 | 2.0 | 3.950 |
| 3 400 | 4 300 | 83.0 | 122.0 | 1.5 | 1.600 |
| 3 000 | 3 800 | 86.0 | 149.0 | 2.0 | 5.380 |
| 3 200 | 4 000 | 89.0 | 131.0 | 2.0 | 2.000 |
| 3 000 | 3 800 | 94.0 | 141.0 | 2.0 | 2.550 |
| 2 800 | 3 600 | 99.0 | 151.0 | 2.0 | 3.200 |

# Maximum Type Ball Bearings

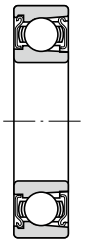
## Bore Diameter 25 – 110 mm




Open Type



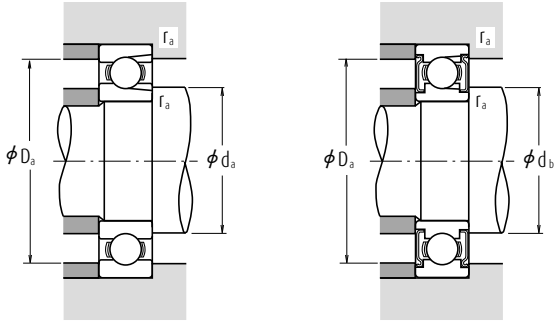
Shielded Type
(One Shield) Z



Shielded Type
(Two Shields) ZZ

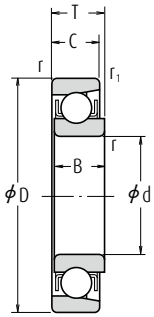
| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Limiting Speeds (min⁻¹) | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Grease | Oil | |
| d | D | B | r min. | $C_r$ | $C_{0r}$ | Open Z · ZZ | Open Z | Open |
| **25** | 52 | 15 | 1 | 14 400 | 10 500 | 12 000 | 15 000 | **BL 205** |
| | 62 | 17 | 1.1 | 21 500 | 15 500 | 11 000 | 13 000 | **BL 305** |
| **30** | 62 | 16 | 1 | 21 000 | 16 300 | 10 000 | 12 000 | **BL 206** |
| | 72 | 19 | 1.1 | 27 900 | 20 700 | 9 000 | 11 000 | **BL 306** |
| **35** | 72 | 17 | 1.1 | 27 800 | 22 100 | 9 000 | 11 000 | **BL 207** |
| | 80 | 21 | 1.5 | 37 000 | 29 100 | 8 000 | 9 500 | **BL 307** |
| **40** | 80 | 18 | 1.1 | 35 500 | 28 800 | 8 000 | 9 500 | **BL 208** |
| | 90 | 23 | 1.5 | 46 500 | 36 000 | 7 500 | 9 000 | **BL 308** |
| **45** | 85 | 19 | 1.1 | 37 000 | 32 000 | 7 500 | 9 000 | **BL 209** |
| | 100 | 25 | 1.5 | 55 500 | 44 000 | 6 300 | 8 000 | **BL 309** |
| **50** | 90 | 20 | 1.1 | 39 000 | 35 000 | 6 700 | 8 500 | **BL 210** |
| | 110 | 27 | 2 | 65 000 | 52 500 | 6 000 | 7 100 | **BL 310** |
| **55** | 100 | 21 | 1.5 | 48 000 | 44 000 | 6 300 | 7 500 | **BL 211** |
| | 120 | 29 | 2 | 75 000 | 61 500 | 5 600 | 6 700 | **BL 311** |
| **60** | 110 | 22 | 1.5 | 58 000 | 54 000 | 5 600 | 6 700 | **BL 212** |
| | 130 | 31 | 2.1 | 85 500 | 71 500 | 5 000 | 6 000 | **BL 312** |
| **65** | 120 | 23 | 1.5 | 63 500 | 60 000 | 5 300 | 6 300 | **BL 213** |
| | 140 | 33 | 2.1 | 103 000 | 89 500 | 4 800 | 5 600 | **BL 313** |
| **70** | 125 | 24 | 1.5 | 69 000 | 66 000 | 5 000 | 6 000 | **BL 214** |
| | 150 | 35 | 2.1 | 115 000 | 102 000 | 4 300 | 5 300 | **BL 314** |
| **75** | 130 | 25 | 1.5 | 72 000 | 72 000 | 4 500 | 5 600 | **BL 215** |
| | 160 | 37 | 2.1 | 126 000 | 116 000 | 4 000 | 5 000 | **BL 315** |
| **80** | 140 | 26 | 2 | 84 000 | 85 000 | 4 300 | 5 300 | **BL 216** |
| | 170 | 39 | 2.1 | 136 000 | 130 000 | 3 800 | 4 500 | **BL 316** |
| **85** | 150 | 28 | 2 | 93 000 | 93 000 | 4 000 | 5 000 | **BL 217** |
| | 180 | 41 | 3 | 147 000 | 145 000 | 3 600 | 4 300 | **BL 317** |
| **90** | 160 | 30 | 2 | 107 000 | 107 000 | 3 800 | 4 500 | **BL 218** |
| | 190 | 43 | 3 | 158 000 | 161 000 | 3 400 | 4 000 | **BL 318** |
| **95** | 170 | 32 | 2.1 | 121 000 | 123 000 | 3 600 | 4 300 | **BL 219** |
| | 200 | 45 | 3 | 169 000 | 178 000 | 2 800 | 3 600 | **BL 319** |
| **100** | 180 | 34 | 2.1 | 136 000 | 140 000 | 3 400 | 4 000 | **BL 220** |
| **105** | 190 | 36 | 2.1 | 148 000 | 157 000 | 3 200 | 3 800 | **BL 221** |
| **110** | 200 | 38 | 2.1 | 160 000 | 176 000 | 2 800 | 3 400 | **BL 222** |

**Remark** When using Maximum Type Ball Bearings, please contact NSK.




| Bearing Numbers | | Abutment and Fillet Dimensions (mm) | | | | Mass (kg) |
|---|---|---|---|---|---|---|
| With One Shielded | With Two Shields | $d_a$ min. | $d_b$ max. | $D_a$ max. | $r_a$ max. | approx. |
| **BL 205 Z** | **BL 205 ZZ** | 30 | 32 | 47 | 1 | 0.133 |
| **BL 305 Z** | **BL 305 ZZ** | 31.5 | 36 | 55.5 | 1 | 0.246 |
| **BL 206 Z** | **BL 206 ZZ** | 35 | 38.5 | 57 | 1 | 0.215 |
| **BL 306 Z** | **BL 306 ZZ** | 36.5 | 42 | 65.5 | 1 | 0.364 |
| **BL 207 Z** | **BL 207 ZZ** | 41.5 | 44.5 | 65.5 | 1 | 0.307 |
| **BL 307 Z** | **BL 307 ZZ** | 43 | 44.5 | 72 | 1.5 | 0.486 |
| **BL 208 Z** | **BL 208 ZZ** | 46.5 | 50 | 73.5 | 1 | 0.394 |
| **BL 308 Z** | **BL 308 ZZ** | 48 | 52.5 | 82 | 1.5 | 0.685 |
| **BL 209 Z** | **BL 209 ZZ** | 51.5 | 55.5 | 78.5 | 1 | 0.449 |
| **BL 309 Z** | **BL 309 ZZ** | 53 | 61.5 | 92 | 1.5 | 0.883 |
| **BL 210 Z** | **BL 210 ZZ** | 56.5 | 60 | 83.5 | 1 | 0.504 |
| **BL 310 Z** | **BL 310 ZZ** | 59 | 68 | 101 | 2 | 1.16 |
| **BL 211 Z** | **BL 211 ZZ** | 63 | 66.5 | 92 | 1.5 | 0.667 |
| **BL 311 Z** | **BL 311 ZZ** | 64 | 72.5 | 111 | 2 | 1.49 |
| **BL 212 Z** | **BL 212 ZZ** | 68 | 74.5 | 102 | 1.5 | 0.856 |
| **BL 312 Z** | **BL 312 ZZ** | 71 | 79 | 119 | 2 | 1.88 |
| **BL 213 Z** | **BL 213 ZZ** | 73 | 80 | 112 | 1.5 | 1.09 |
| **BL 313 Z** | **BL 313 ZZ** | 76 | 85.5 | 129 | 2 | 2.36 |
| **BL 214 Z** | **BL 214 ZZ** | 78 | 84 | 117 | 1.5 | 1.19 |
| **BL 314 Z** | **BL 314 ZZ** | 81 | 92 | 139 | 2 | 2.87 |
| **BL 215 Z** | **BL 215 ZZ** | 83 | 90 | 122 | 1.5 | 1.29 |
| **BL 315 Z** | **BL 315 ZZ** | 86 | 98.5 | 149 | 2 | 3.43 |
| **BL 216 Z** | **BL 216 ZZ** | 89 | 95.5 | 131 | 2 | 1.61 |
| **BL 316 Z** | **BL 316 ZZ** | 91 | 104.5 | 159 | 2 | 4.08 |
| **BL 217 Z** | **BL 217 ZZ** | 94 | 102 | 141 | 2 | 1.97 |
| **BL 317 Z** | **BL 317 ZZ** | 98 | 110.5 | 167 | 2.5 | 4.77 |
| **BL 218 Z** | **BL 218 ZZ** | 99 | 107.5 | 151 | 2 | 2.43 |
| **BL 318 Z** | **BL 318 ZZ** | 103 | 117 | 177 | 2.5 | 5.45 |
| **BL 219 Z** | **BL 219 ZZ** | 106 | 114 | 159 | 2 | 2.95 |
| **BL 319 Z** | **BL 319 ZZ** | 108 | 124 | 187 | 2.5 | 6.4 |
| **BL 220 Z** | **BL 220 ZZ** | 111 | 121.5 | 169 | 2 | 3.54 |
| **BL 221 Z** | **BL 221 ZZ** | 116 | 127.5 | 179 | 2 | 4.23 |
| — | — | 121 | — | 189 | 2 | 4.84 |

## Bore Diameter 4 – 20 mm




## Outside Diameter Tolerance (Class N) Units: μm

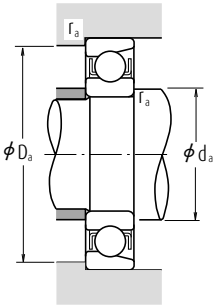
| Nominal Outside Diameter D (mm) | | Single Plane Mean Outside Diameter $\Delta_{D_{mp}}$ | | | |
|---|---|---|---|---|---|
| | | E Series | | EN Series | |
| Over | Incl. | High | Low | High | Low |
| — | 10 | +8 | 0 | 0 | −8 |
| 10 | 18 | +8 | 0 | 0 | −8 |
| 18 | 30 | +9 | 0 | 0 | −9 |
| 30 | 50 | +11 | 0 | 0 | −11 |

| Boundary Dimensions (mm) | | | | | Basic Load Ratings (N) | | Limiting Speeds ($min^{-1}$) | | Bearing Numbers | |
|---|---|---|---|---|---|---|---|---|---|---|
| d | D | B,C,T | r min. | $r_1$ min. | $C_r$ | $C_{0r}$ | Grease | Oil | E Series | EN Series |
| **4** | 16 | 5 | 0.15 | 0.1 | 1 650 | 288 | 34 000 | 40 000 | **E 4** | **EN 4** |
| **5** | 16 | 5 | 0.15 | 0.1 | 1 650 | 288 | 34 000 | 40 000 | **E 5** | **EN 5** |
| **6** | 21 | 7 | 0.3 | 0.15 | 2 490 | 445 | 30 000 | 36 000 | **E 6** | **EN 6** |
| **7** | 22 | 7 | 0.3 | 0.15 | 2 490 | 445 | 30 000 | 36 000 | **E 7** | **EN 7** |
| **8** | 24 | 7 | 0.3 | 0.15 | 3 450 | 650 | 28 000 | 34 000 | **E 8** | **EN 8** |
| **9** | 28 | 8 | 0.3 | 0.15 | 4 550 | 880 | 24 000 | 30 000 | **E 9** | **EN 9** |
| **10** | 28 | 8 | 0.3 | 0.15 | 4 550 | 880 | 24 000 | 30 000 | **E 10** | **EN 10** |
| **11** | 32 | 7 | 0.3 | 0.15 | 4 400 | 845 | 22 000 | 26 000 | **E 11** | **EN 11** |
| **12** | 32 | 7 | 0.3 | 0.15 | 4 400 | 845 | 22 000 | 26 000 | **E 12** | **EN 12** |
| **13** | 30 | 7 | 0.3 | 0.15 | 4 400 | 845 | 22 000 | 26 000 | **E 13** | **EN 13** |
| **14** | 35 | 8 | 0.3 | 0.15 | 5 800 | 1 150 | 19 000 | 22 000 | — | **EN 14** |
| **15** | 35 | 8 | 0.3 | 0.15 | 5 800 | 1 150 | 19 000 | 22 000 | **E 15** | **EN 15** |
| | 40 | 10 | 0.6 | 0.3 | 7 400 | 1 500 | 17 000 | 20 000 | **BO 15** | — |
| **16** | 38 | 10 | 0.6 | 0.2 | 6 900 | 1 380 | 17 000 | 22 000 | — | **EN 16** |
| **17** | 40 | 10 | 0.6 | 0.3 | 7 400 | 1 500 | 17 000 | 20 000 | **L 17** | — |
| | 44 | 11 | 0.6 | 0.3 | 7 350 | 1 500 | 16 000 | 19 000 | — | **EN 17** |
| | 44 | 11 | 0.6 | 0.3 | 7 350 | 1 500 | 16 000 | 19 000 | **BO 17** | — |
| **18** | 40 | 9 | 0.6 | 0.2 | 5 050 | 1 030 | 17 000 | 20 000 | — | **EN 18** |
| **19** | 40 | 9 | 0.6 | 0.2 | 5 050 | 1 030 | 17 000 | 20 000 | **E 19** | **EN 19** |
| **20** | 47 | 12 | 1 | 0.6 | 11 000 | 2 380 | 14 000 | 17 000 | **E 20** | **EN 20** |
| | 47 | 14 | 1 | 0.6 | 11 000 | 2 380 | 14 000 | 17 000 | **L 20** | — |

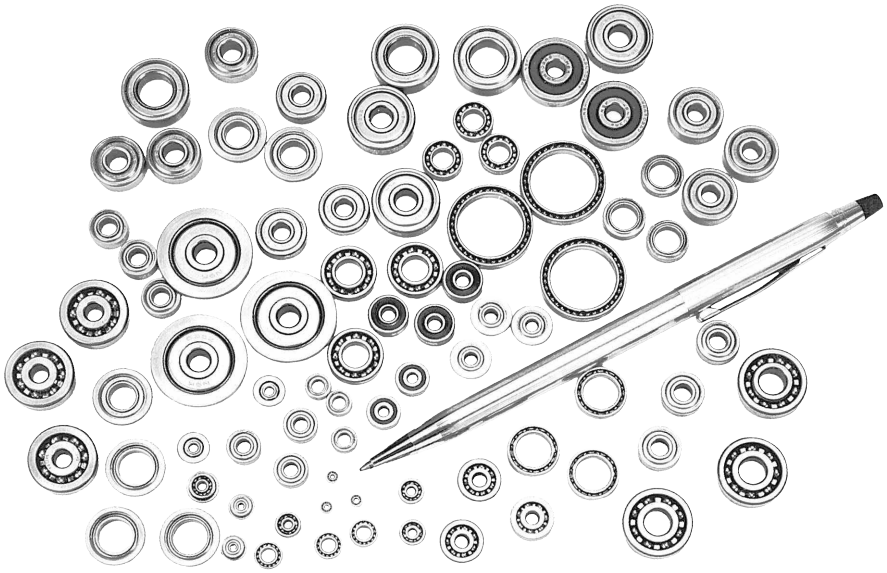
**Remarks** 1. The outside diameters of Magneto Bearings Series E always have plus tolerances.
2. When using Magneto Bearings other than E, please contact NSK.

## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | | e |
|---|---|---|---|---|
| X | Y | X | Y | |
| 1 | 0 | 0.5 | 2.5 | 0.2 |




| Abutment and Fillet Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|
| $d_a$ min. | $D_a$ max. | $r_a$ max. | approx. |
| 5.2 | 14.8 | 0.15 | 0.005 |
| 6.2 | 14.8 | 0.15 | 0.004 |
| 8 | 19 | 0.3 | 0.011 |
| 9 | 20 | 0.3 | 0.013 |
| 10 | 22 | 0.3 | 0.014 |
| 11 | 26 | 0.3 | 0.022 |
| 12 | 26 | 0.3 | 0.021 |
| 13 | 30 | 0.3 | 0.029 |
| 14 | 30 | 0.3 | 0.028 |
| 15 | 28 | 0.3 | 0.021 |
| 16 | 33 | 0.3 | 0.035 |
| 17 | 33 | 0.3 | 0.034 |
| 19 | 36 | 0.6 | 0.055 |
| 20 | 34 | 0.6 | 0.049 |
| 21 | 36 | 0.6 | 0.051 |
| 21 | 40 | 0.6 | 0.080 |
| 21 | 40 | 0.6 | 0.080 |
| 22 | 36 | 0.6 | 0.051 |
| 23 | 36 | 0.6 | 0.049 |
| 25 | 42 | 1 | 0.089 |
| 25 | 42 | 1 | 0.101 |



## 2. EXTRA SMALL BALL BEARINGS AND MINIATURE BALL BEARINGS

INTRODUCTION ..... B 056
BEARINGS TABLE

### EXTRA SMALL BALL BEARINGS · MINIATURE BALL BEARINGS


| | Bore Dia. | Page |
|---|---|---|
| Metric Design | 1 – 9 mm | B 060 |
| With Flange | 1 – 9 mm | B 064 |
| Inch Design | 1.016 – 9.525 mm | B 068 |
| With Flange | 1.191 – 9.525 mm | B 070 |

## DESIGN AND TYPES

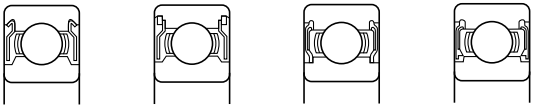
The size ranges of extra small and miniature ball bearings are shown in Table 1. The design, types, and type symbols are shown in Table 2. Those types among them that are listed in the bearing tables are indicated by the shading in Table 2.

### Table 1 Size Ranges of Bearings

Units : mm

| Design | Extra Small Ball Bearings | Miniature Ball Bearings |
|---|---|---|
| **Metric** | Outside diameter $D \geqq 9$<br>Bore diameter $d < 10$ | Outside diameter $D < 9$ |
| **Inch** | Outside diameter $D \geqq 9.525$<br>Bore diameter $d < 10$ | Outside diameter $D < 9.525$ |

Please refer to NSK Miniature Ball Bearings (CAT. No. E126) for details.



ZZ ZZS DD VV

## Table 2 Design, Types, and Type Symbols

| Design · Types | | Type Symbols | | | | Remarks |
|---|---|---|---|---|---|---|
| | | Metric | Inch | Special | | |
| | | | | Metric | Inch | |
| Single-Row Deep Groove Ball Bearings |  | 6 ◯ ◯ | R | MR | – | Shielded · sealed bearings are available. |
| | Thin section  | – | – | SMT | – | |
| | With flange  | F6 ◯ ◯ | FR | MF | – | Shielded · sealed bearings are available. |
| | Extended inner ring  | – | – | – | RW | Shielded bearings are available. |
| | With flange and extended inner ring  | – | – | – | FRW | Shielded bearings are available. |
| | For synchro motors  | – | – | – | SR00X00 | Shielded bearings are available. |
| Pivot Ball Bearings |  | – | – | BCF | – | |
| Thrust Ball Bearings |  | – | – | F | – | |

**Remark** Single-row angular contact ball bearings are available besides those shown above.

## TOLERANCES AND RUNNING ACCURACY

Table Pages
Metric Design Bearings 7.3 ..... A132 to A135

The flange tolerances for metric design bearings are listed in Table 3.

### Table 3 Flange Tolerances for Metric Flanged Bearings

(1) Tolerances of Flange Outside Diameter Units : μm

| Nominal Flange Outside Diameter $D_1$(mm) | | Deviation of Flange Outside Diameter $\Delta_{D1S}$ | | | |
|---|---|---|---|---|---|
| | | ① | | ② | |
| over | incl. | high | low | high | low |
| | 10 | +220 | −36 | 0 | −36 |
| 10 | 18 | +270 | −43 | 0 | −43 |
| 18 | 30 | +330 | −52 | 0 | −52 |

Remark ② is applied when the flange outside diameter is used for positioning.

(2) Flange Width Tolerances and Running Accuracies Related to Flange Units : μm

| Nominal Bearing Outside Diameter D (mm) | | Deviation of Flange Width $\Delta_{C1S}$ | Variation of Flange Width $\Delta_{C1S}$ $VC_{1S}$ | | | | Variation of Bearing Outside Surface Generatrix Inclination with Flange Backface $S_{D1}$ | | | Flange Backface Runout with Raceway $S_{ea1}$ | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Normal and Classes 6,5,4,2 | Normal and class 6 | Class 5 | Class 4 | Class 2 | Class 5 | Class 4 | Class 2 | Class 5 | Class 4 | Class 2 |
| over | incl. | high low | max. | | | | max. | | | max. | | |
| 2.5(1) | 6 | Use the $\Delta_{BS}$ tolerance for d of the same bearing of the same class | Use the $\Delta_{VBS}$ tolerance for d of the same bearing of the same class | 5 | 2.5 | 1.5 | 8 | 4 | 1.5 | 11 | 7 | 3 |
| 6 | 18 | | | 5 | 2.5 | 1.5 | 8 | 4 | 1.5 | 11 | 7 | 3 |
| 18 | 30 | | | 5 | 2.5 | 1.5 | 8 | 4 | 1.5 | 11 | 7 | 3 |

Note (1) 2.5 mm is included

Table Pages
Inch Design Bearings 7.4 ..... A136 to A137

The flange tolerances for inch design flanged bearings are listed in Table 7.9 (2) (Pages A146 and A147).

Instrument Ball Bearings 7.9 ..... A146 to A147

## RECOMMENDED FITS

Please refer to NSK Miniature Ball Bearings (CAT.No.E126).

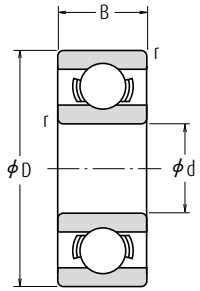
## INTERNAL CLEARANCES

Table Page
8.11 ..... A169

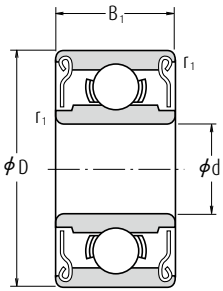
## LIMITING SPEEDS

The limiting speeds listed in the bearing tables should be adjusted depending on the bearing toad conditions. Also, higher speeds are attainable by making changes in the lubrication method, cage design, etc. Refer to Page A098 for detailed information.

## Metric Design
## Bore Diameter 1 – 4 mm




Open Type

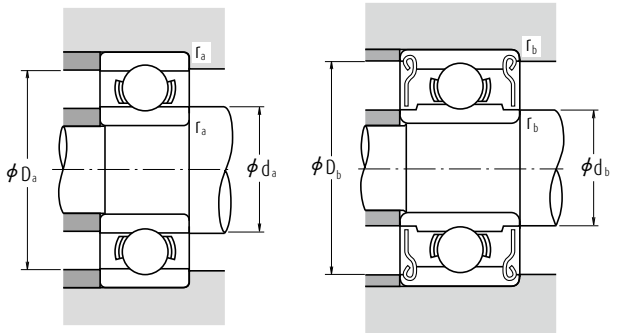



Shielded Type
ZZ · ZZ1

| Boundary Dimensions (mm) | | | | | | Basic Load Ratings (N) | | Limiting Speeds (min⁻¹) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Grease | Oil | |
| d | D | B | $B_1$ | r(1) min. | $r_1$(1) min. | $C_r$ | $C_{0r}$ | Open Z · ZZ | Open Z | Open |
| 1 | 3 | 1 | — | 0.05 | — | 80 | 23 | 130 000 | 150 000 | 681 |
| | 3 | 1.5 | — | 0.05 | — | 80 | 23 | 130 000 | 150 000 | MR 31 |
| | 4 | 1.6 | — | 0.1 | — | 138 | 35 | 100 000 | 120 000 | 691 |
| 1.2 | 4 | 1.8 | 2.5 | 0.1 | 0.1 | 138 | 35 | 110 000 | 130 000 | MR 41 X |
| 1.5 | 4 | 1.2 | 2 | 0.05 | 0.05 | 112 | 33 | 100 000 | 120 000 | 681 X |
| | 5 | 2 | 2.6 | 0.15 | 0.15 | 237 | 69 | 85 000 | 100 000 | 691 X |
| | 6 | 2.5 | 3 | 0.15 | 0.15 | 330 | 98 | 75 000 | 90 000 | 601 X |
| 2 | 5 | 1.5 | 2.3 | 0.08 | 0.08 | 169 | 50 | 85 000 | 100 000 | 682 |
| | 5 | 2 | 2.5 | 0.1 | 0.1 | 187 | 58 | 85 000 | 100 000 | MR 52 B |
| | 6 | 2.3 | 3 | 0.15 | 0.15 | 330 | 98 | 75 000 | 90 000 | 692 |
| | 6 | 2.5 | 2.5 | 0.15 | 0.15 | 330 | 98 | 75 000 | 90 000 | MR 62 |
| | 7 | 2.5 | 3 | 0.15 | 0.15 | 385 | 127 | 63 000 | 75 000 | MR 72 |
| | 7 | 2.8 | 3.5 | 0.15 | 0.15 | 385 | 127 | 63 000 | 75 000 | 602 |
| 2.5 | 6 | 1.8 | 2.6 | 0.08 | 0.08 | 208 | 74 | 71 000 | 80 000 | 682 X |
| | 7 | 2.5 | 3.5 | 0.15 | 0.15 | 385 | 127 | 63 000 | 75 000 | 692 X |
| | 8 | 2.5 | — | 0.2 | — | 560 | 179 | 60 000 | 67 000 | MR 82 X |
| | 8 | 2.8 | 4 | 0.15 | 0.15 | 550 | 175 | 60 000 | 71 000 | 602 X |
| 3 | 6 | 2 | 2.5 | 0.1 | 0.1 | 208 | 74 | 71 000 | 80 000 | MR 63 |
| | 7 | 2 | 3 | 0.1 | 0.1 | 390 | 130 | 63 000 | 75 000 | 683 A |
| | 8 | 2.5 | — | 0.15 | — | 560 | 179 | 60 000 | 67 000 | MR 83 |
| | 8 | 3 | 4 | 0.15 | 0.15 | 560 | 179 | 60 000 | 67 000 | 693 |
| | 9 | 2.5 | 4 | 0.2 | 0.15 | 570 | 187 | 56 000 | 67 000 | MR 93 |
| | 9 | 3 | 5 | 0.15 | 0.15 | 570 | 187 | 56 000 | 67 000 | 603 |
| | 10 | 4 | 4 | 0.15 | 0.15 | 630 | 218 | 50 000 | 60 000 | 623 |
| | 13 | 5 | 5 | 0.2 | 0.2 | 1 300 | 485 | 40 000 | 48 000 | 633 |
| 4 | 7 | 2 | — | 0.1 | — | 310 | 115 | 60 000 | 67 000 | MR 74 |
| | 7 | — | 2.5 | — | 0.1 | 255 | 107 | 60 000 | 71 000 | — |
| | 8 | 2 | 3 | 0.15 | 0.1 | 395 | 139 | 56 000 | 67 000 | MR 84 |
| | 9 | 2.5 | 4 | (0.15) | (0.15) | 640 | 225 | 53 000 | 63 000 | 684 A |
| | 10 | 3 | 4 | 0.2 | 0.15 | 710 | 270 | 50 000 | 60 000 | MR 104 B |
| | 11 | 4 | 4 | 0.15 | 0.15 | 960 | 345 | 48 000 | 56 000 | 694 |
| | 12 | 4 | 4 | 0.2 | 0.2 | 960 | 345 | 48 000 | 56 000 | 604 |
| | 13 | 5 | 5 | 0.2 | 0.2 | 1 300 | 485 | 40 000 | 48 000 | 624 |
| | 16 | 5 | 5 | 0.3 | 0.3 | 1 730 | 670 | 36 000 | 43 000 | 634 |

**Note** (1) The values in parentheses are not based on ISO 15.

**Remark** When using bearings with a rotating outer ring, please contact NSK if they are shielded.

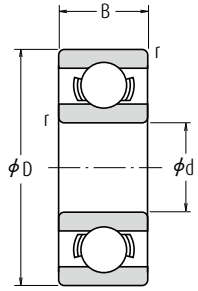



## Radial and axial load factors

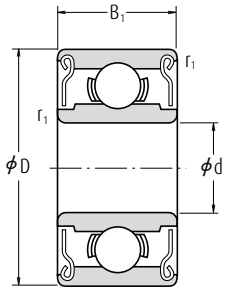
| $C_{or}/F_a$ | $F_a/F_r \leq e$ | | $F_a/F_r > e$ | | e |
|---|---|---|---|---|---|
| | X | Y | X | Y | |
| 5 | 1 | 0 | 0.56 | 1.26 | 0.35 |
| 10 | 1 | 0 | 0.56 | 1.49 | 0.29 |
| 15 | 1 | 0 | 0.56 | 1.64 | 0.27 |
| 20 | 1 | 0 | 0.56 | 1.76 | 0.25 |
| 25 | 1 | 0 | 0.56 | 1.85 | 0.24 |
| 30 | 1 | 0 | 0.56 | 1.92 | 0.23 |
| 50 | 1 | 0 | 0.56 | 2.13 | 0.20 |

| Bearing Numbers | | | Abutment and Fillet Dimensions (mm) | | | | | | Mass (g) | |
|---|---|---|---|---|---|---|---|---|---|---|
| Shielded | Sealed | | $d_a$ min. | $d_b$ max. | $D_a$ max. | $D_b$ min. | $r_a$ max. | $r_b$ max. | approx. Open | Shielded |
| — | — | — | 1.4 | — | 2.6 | — | 0.05 | — | 0.03 | — |
| — | — | — | 1.4 | — | 2.6 | — | 0.05 | — | 0.04 | — |
| — | — | — | 1.8 | — | 3.2 | — | 0.1 | — | 0.09 | — |
| MR 41 XZZ | — | — | 2.0 | 1.9 | 3.2 | 3.5 | 0.1 | 0.1 | 0.10 | 0.14 |
| 681 XZZ | — | — | 1.9 | 2.1 | 3.6 | 3.6 | 0.05 | 0.05 | 0.07 | 0.11 |
| 691 XZZ | — | — | 2.7 | 2.5 | 3.8 | 4.3 | 0.15 | 0.15 | 0.17 | 0.20 |
| 601 XZZ | — | — | 2.7 | 3.0 | 4.8 | 5.4 | 0.15 | 0.15 | 0.33 | 0.38 |
| 682 ZZ | — | — | 2.6 | 2.7 | 4.4 | 4.2 | 0.08 | 0.08 | 0.12 | 0.17 |
| MR 52 BZZ | — | — | 2.8 | 2.7 | 4.2 | 4.4 | 0.1 | 0.1 | 0.16 | 0.23 |
| 692 ZZ | — | — | 3.2 | 3.0 | 4.8 | 5.4 | 0.15 | 0.15 | 0.28 | 0.38 |
| MR 62 ZZ | — | — | 3.2 | 3.0 | 4.8 | 5.2 | 0.15 | 0.15 | 0.30 | 0.29 |
| MR 72 ZZ | — | — | 3.2 | 3.8 | 5.8 | 6.2 | 0.15 | 0.15 | 0.45 | 0.49 |
| 602 ZZ | — | — | 3.2 | 3.8 | 5.8 | 6.2 | 0.15 | 0.15 | 0.51 | 0.58 |
| 682 XZZ | — | — | 3.1 | 3.7 | 5.4 | 5.4 | 0.08 | 0.08 | 0.23 | 0.29 |
| 692 XZZ | — | — | 3.7 | 3.8 | 5.8 | 6.2 | 0.15 | 0.15 | 0.41 | 0.55 |
| — | — | — | 4.1 | — | 6.4 | — | 0.2 | — | 0.56 | — |
| 602 XZZ | — | — | 3.7 | 4.1 | 6.8 | 7.0 | 0.15 | 0.15 | 0.63 | 0.83 |
| MR 63 ZZ | — | — | 3.8 | 3.7 | 5.2 | 5.4 | 0.1 | 0.1 | 0.20 | 0.27 |
| 683 AZZ | — | — | 3.8 | 4.0 | 6.2 | 6.4 | 0.1 | 0.1 | 0.32 | 0.45 |
| — | — | — | 4.2 | — | 6.8 | — | 0.15 | — | 0.54 | — |
| 693 ZZ | — | — | 4.2 | 4.3 | 6.8 | 7.3 | 0.15 | 0.15 | 0.61 | 0.83 |
| MR 93 ZZ | — | — | 4.6 | 4.3 | 7.4 | 7.9 | 0.2 | 0.15 | 0.73 | 1.18 |
| 603 ZZ | — | — | 4.2 | 4.3 | 7.8 | 7.9 | 0.15 | 0.15 | 0.87 | 1.45 |
| 623 ZZ | — | — | 4.2 | 4.3 | 8.8 | 8.0 | 0.15 | 0.15 | 1.65 | 1.66 |
| 633 ZZ | — | — | 4.6 | 6.0 | 11.4 | 11.3 | 0.2 | 0.2 | 3.38 | 3.33 |
| — | — | — | 4.8 | — | 6.2 | — | 0.1 | — | 0.22 | — |
| MR 74 ZZ | — | — | — | 4.8 | — | 6.3 | — | 0.1 | — | 0.29 |
| MR 84 ZZ | — | — | 5.2 | 5.0 | 6.8 | 7.4 | 0.15 | 0.1 | 0.36 | 0.56 |
| 684 AZZ | — | — | 4.8 | 5.2 | 8.2 | 8.1 | 0.1 | 0.1 | 0.63 | 1.01 |
| MR 104 BZZ | — | — | 5.6 | 5.9 | 8.4 | 8.8 | 0.2 | 0.15 | 1.04 | 1.42 |
| 694 ZZ | — | — | 5.2 | 5.6 | 9.8 | 9.9 | 0.15 | 0.15 | 1.7 | 1.75 |
| 604 ZZ | — | — | 5.6 | 5.6 | 10.4 | 9.9 | 0.2 | 0.2 | 2.25 | 2.29 |
| 624 ZZ | — | — | 5.6 | 6.0 | 11.4 | 11.3 | 0.2 | 0.2 | 3.03 | 3.04 |
| 634 ZZ1 | — | — | 6.0 | 7.5 | 14.0 | 13.8 | 0.3 | 0.3 | 5.24 | 5.21 |

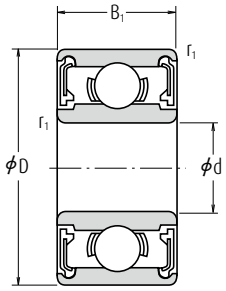
## Metric Design
## Bore Diameter 5 – 9 mm



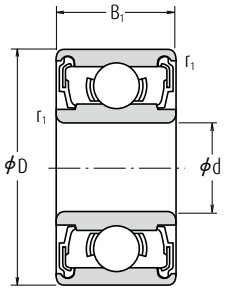
Open Type



Shielded Type
ZZ · ZZ1



Non-Contact
Sealed Type VV

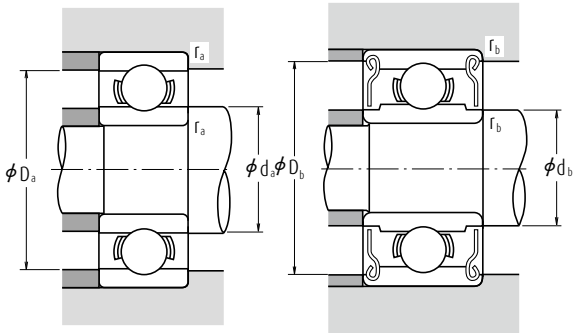


Contact
Sealed Type DD

| Boundary Dimensions (mm) | | | | | | Basic Load Ratings (N) | | Limiting Speeds (min⁻¹) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Grease | | Oil | |
| d | D | B | $B_1$ | r(1) min. | $r_1$(1) min. | $C_r$ | $C_{0r}$ | Open Z · ZZ V · VV | D · DD | Open Z | Open |
| **5** | 8 | 2 | — | 0.1 | — | 310 | 120 | 53 000 | — | 63 000 | **MR 85** |
| | 8 | — | 2.5 | — | 0.1 | 278 | 131 | 53 000 | — | 63 000 | — |
| | 9 | 2.5 | 3 | 0.15 | 0.15 | 430 | 168 | 50 000 | — | 60 000 | **MR 95** |
| | 10 | 3 | 4 | 0.15 | 0.15 | 430 | 168 | 50 000 | — | 60 000 | **MR 105** |
| | 11 | — | 4 | — | 0.15 | 715 | 276 | 48 000 | — | 56 000 | — |
| | 11 | 3 | 5 | 0.15 | 0.15 | 715 | 281 | 45 000 | — | 53 000 | **685** |
| | 13 | 4 | 4 | 0.2 | 0.2 | 1 080 | 430 | 43 000 | 40 000 | 50 000 | **695** |
| | 14 | 5 | 5 | 0.2 | 0.2 | 1 330 | 505 | 40 000 | 38 000 | 50 000 | **605** |
| | 16 | 5 | 5 | 0.3 | 0.3 | 1 730 | 670 | 36 000 | 32 000 | 43 000 | **625** |
| | 19 | 6 | 6 | 0.3 | 0.3 | 2 340 | 885 | 32 000 | 30 000 | 40 000 | **635** |
| **6** | 10 | 2.5 | 3 | 0.15 | 0.1 | 495 | 218 | 45 000 | — | 53 000 | **MR 106** |
| | 12 | 3 | 4 | 0.2 | 0.15 | 715 | 292 | 43 000 | 40 000 | 50 000 | **MR 126** |
| | 13 | 3.5 | 5 | 0.15 | 0.15 | 1 080 | 440 | 40 000 | 38 000 | 50 000 | **686 A** |
| | 15 | 5 | 5 | 0.2 | 0.2 | 1 730 | 670 | 40 000 | 36 000 | 45 000 | **696** |
| | 17 | 6 | 6 | 0.3 | 0.3 | 2 260 | 835 | 38 000 | 34 000 | 45 000 | **606** |
| | 19 | 6 | 6 | 0.3 | 0.3 | 2 340 | 885 | 32 000 | 30 000 | 40 000 | **626** |
| | 22 | 7 | 7 | 0.3 | 0.3 | 3 300 | 1 370 | 30 000 | 28 000 | 36 000 | **636** |
| **7** | 11 | 2.5 | 3 | 0.15 | 0.1 | 455 | 201 | 43 000 | — | 50 000 | **MR 117** |
| | 13 | 3 | 4 | 0.2 | 0.15 | 540 | 276 | 40 000 | — | 48 000 | **MR 137** |
| | 14 | 3.5 | 5 | 0.15 | 0.15 | 1 170 | 510 | 40 000 | 34 000 | 45 000 | **687** |
| | 17 | 5 | 5 | 0.3 | 0.3 | 1 610 | 710 | 36 000 | 28 000 | 43 000 | **697** |
| | 19 | 6 | 6 | 0.3 | 0.3 | 2 340 | 885 | 36 000 | 32 000 | 43 000 | **607** |
| | 22 | 7 | 7 | 0.3 | 0.3 | 3 300 | 1 370 | 30 000 | 28 000 | 36 000 | **627** |
| | 26 | 9 | 9 | 0.3 | 0.3 | 4 550 | 1 970 | 28 000 | 22 000 | 34 000 | **637** |
| **8** | 12 | 2.5 | 3.5 | 0.15 | 0.1 | 545 | 274 | 40 000 | — | 48 000 | **MR 128** |
| | 14 | 3.5 | 4 | 0.2 | 0.15 | 820 | 385 | 38 000 | 32 000 | 45 000 | **MR 148** |
| | 16 | 4 | 5 | 0.2 | 0.2 | 1 610 | 710 | 36 000 | 28 000 | 43 000 | **688 A** |
| | 19 | 6 | 6 | 0.3 | 0.3 | 2 240 | 910 | 36 000 | 28 000 | 43 000 | **698** |
| | 22 | 7 | 7 | 0.3 | 0.3 | 3 300 | 1 370 | 34 000 | 28 000 | 40 000 | **608** |
| | 24 | 8 | 8 | 0.3 | 0.3 | 3 350 | 1 430 | 28 000 | 24 000 | 34 000 | **628** |
| | 28 | 9 | 9 | 0.3 | 0.3 | 4 550 | 1 970 | 28 000 | 22 000 | 34 000 | **638** |
| **9** | 17 | 4 | 5 | 0.2 | 0.2 | 1 330 | 665 | 36 000 | 24 000 | 43 000 | **689** |
| | 20 | 6 | 6 | 0.3 | 0.3 | 1 720 | 840 | 34 000 | 24 000 | 40 000 | **699** |
| | 24 | 7 | 7 | 0.3 | 0.3 | 3 350 | 1 430 | 32 000 | 24 000 | 38 000 | **609** |
| | 26 | 8 | 8 | (0.6) | (0.6) | 4 550 | 1 970 | 28 000 | 22 000 | 34 000 | **629** |
| | 30 | 10 | 10 | 0.6 | 0.6 | 5 100 | 2 390 | 24 000 | — | 30 000 | **639** |

**Note** (1) The values in parentheses are not based on ISO 15.

**Remarks** 1. When using bearings with a rotating outer ring, please contact NSK if they are sealed or shielded.
2. Bearings with snap rings are also available, please contact NSK.

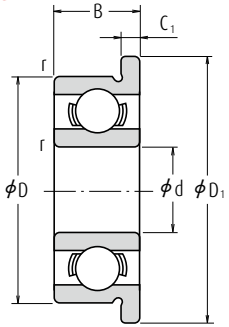



## Radial and axial load factors

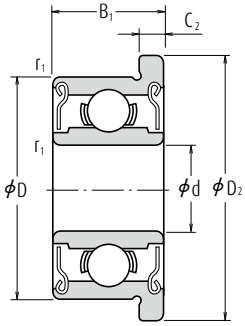
| $C_{or}/F_a$ | $F_a/F_r \leq e$ | | $F_a/F_r > e$ | | e |
|---|---|---|---|---|---|
| | X | Y | X | Y | |
| 5 | 1 | 0 | 0.56 | 1.26 | 0.35 |
| 10 | 1 | 0 | 0.56 | 1.49 | 0.29 |
| 15 | 1 | 0 | 0.56 | 1.64 | 0.27 |
| 20 | 1 | 0 | 0.56 | 1.76 | 0.25 |
| 25 | 1 | 0 | 0.56 | 1.85 | 0.24 |
| 30 | 1 | 0 | 0.56 | 1.92 | 0.23 |
| 50 | 1 | 0 | 0.56 | 2.13 | 0.20 |

| Bearing Numbers | | | Abutment and Fillet Dimensions (mm) | | | | | | Mass (g) | |
|---|---|---|---|---|---|---|---|---|---|---|
| Shielded | Sealed | | $d_a$ min. | $d_b$ max. | $D_a$ max. | $D_b$ min. | $r_a$ max. | $r_b$ max. | approx. Open | approx. Shielded |
| — | — | — | 5.8 | — | 7.2 | — | 0.1 | — | 0.26 | — |
| MR 85 ZZ | — | — | — | 5.8 | — | 7.4 | — | 0.1 | — | 0.34 |
| MR 95 ZZ1 | — | — | 6.2 | 6.0 | 7.8 | 8.2 | 0.15 | 0.15 | 0.50 | 0.58 |
| MR 105 ZZ | — | — | 6.2 | 6.0 | 8.8 | 8.4 | 0.15 | 0.15 | 0.95 | 1.29 |
| MR 115 ZZ | VV | — | — | 6.3 | — | 9.8 | — | 0.15 | — | 1.49 |
| 685 ZZ | — | — | 6.2 | 6.2 | 9.8 | 9.9 | 0.15 | 0.15 | 1.2 | 1.96 |
| 695 ZZ | VV | DD | 6.6 | 6.6 | 11.4 | 11.2 | 0.2 | 0.2 | 2.45 | 2.5 |
| 605 ZZ | — | DD | 6.6 | 6.9 | 12.4 | 12.2 | 0.2 | 0.2 | 3.54 | 3.48 |
| 625 ZZ1 | VV | DD | 7.0 | 7.5 | 14.0 | 13.8 | 0.3 | 0.3 | 4.95 | 4.86 |
| 635 ZZ1 | VV | DD | 7.0 | 8.5 | 17.0 | 16.5 | 0.3 | 0.3 | 8.56 | 8.34 |
| MR 106 ZZ1 | — | — | 7.2 | 7.0 | 8.8 | 9.3 | 0.15 | 0.1 | 0.56 | 0.68 |
| MR 126 ZZ | — | DD | 7.6 | 7.2 | 10.4 | 10.9 | 0.2 | 0.15 | 1.27 | 1.74 |
| 686 AZZ | VV | DD | 7.2 | 7.4 | 11.8 | 11.7 | 0.15 | 0.15 | 1.91 | 2.69 |
| 696 ZZ1 | VV | DD | 7.6 | 7.9 | 13.4 | 13.3 | 0.2 | 0.2 | 3.88 | 3.72 |
| 606 ZZ | VV | DD | 8.0 | 8.2 | 15.0 | 14.8 | 0.3 | 0.3 | 5.97 | 6.08 |
| 626 ZZ1 | VV | DD | 8.0 | 8.5 | 17.0 | 16.5 | 0.3 | 0.3 | 8.15 | 7.94 |
| 636 ZZ | VV | DD | 8.0 | 10.5 | 20.0 | 19.0 | 0.3 | 0.3 | 14 | 14 |
| MR 117 ZZ | — | — | 8.2 | 8.0 | 9.8 | 10.5 | 0.15 | 0.1 | 0.62 | 0.72 |
| MR 137 ZZ | — | — | 8.6 | 9.0 | 11.4 | 11.6 | 0.2 | 0.15 | 1.58 | 2.02 |
| 687 ZZ1 | VV | DD | 8.2 | 8.5 | 12.8 | 12.7 | 0.15 | 0.15 | 2.13 | 2.97 |
| 697 ZZ1 | VV | DD | 9.0 | 10.2 | 15.0 | 14.8 | 0.3 | 0.3 | 5.26 | 5.12 |
| 607 ZZ1 | VV | DD | 9.0 | 9.1 | 17.0 | 16.5 | 0.3 | 0.3 | 7.67 | 7.51 |
| 627 ZZ | VV | DD | 9.0 | 10.5 | 20.0 | 19.0 | 0.3 | 0.3 | 12.7 | 12.9 |
| 637 ZZ1 | VV | DD | 9.0 | 12.8 | 24.0 | 22.8 | 0.3 | 0.3 | 24 | 25 |
| MR 128 ZZ1 | — | — | 9.2 | 9.0 | 10.8 | 11.3 | 0.15 | 0.1 | 0.71 | 0.97 |
| MR 148 ZZ | VV | DD | 9.6 | 9.2 | 12.4 | 12.8 | 0.2 | 0.15 | 1.86 | 2.16 |
| 688 AZZ1 | VV | DD | 9.6 | 10.2 | 14.4 | 14.2 | 0.2 | 0.2 | 3.12 | 4.02 |
| 698 ZZ | VV | DD | 10.0 | 10.0 | 17.0 | 16.5 | 0.3 | 0.3 | 7.23 | 7.18 |
| 608 ZZ | VV | DD | 10.0 | 10.5 | 20.0 | 19.0 | 0.3 | 0.3 | 12.1 | 12.2 |
| 628 ZZ | VV | DD | 10.0 | 12.0 | 22.0 | 20.5 | 0.3 | 0.3 | 17.2 | 17.4 |
| 638 ZZ1 | VV | DD | 10.0 | 12.8 | 26.0 | 22.8 | 0.3 | 0.3 | 28.3 | 28.6 |
| 689 ZZ1 | VV | DD | 10.6 | 11.5 | 15.4 | 15.2 | 0.2 | 0.2 | 3.53 | 4.43 |
| 699 ZZ1 | VV | DD | 11.0 | 12.0 | 18.0 | 17.2 | 0.3 | 0.3 | 8.45 | 8.33 |
| 609 ZZ | VV | DD | 11.0 | 12.0 | 22.8 | 20.5 | 0.3 | 0.3 | 14.5 | 14.7 |
| 629 ZZ | VV | DD | 11.0 | 12.8 | 24.0 | 22.8 | 0.3 | 0.3 | 19.5 | 19.3 |
| 639 ZZ | VV | — | 13.0 | 16.1 | 26.0 | 25.6 | 0.6 | 0.6 | 36.5 | 36 |

## Metric Design With Flange
## Bore Diameter 1 – 4 mm




Open Type

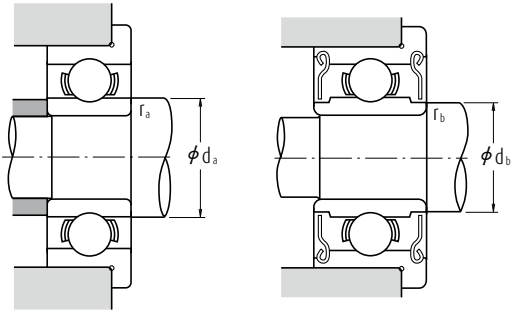



Shielded Type
ZZ · ZZ1

| Boundary Dimensions (mm) | | | | | | | | | | Basic Load Ratings (N) | | Limiting Speeds (min⁻¹) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | Grease | Oil |
| d | D | $D_1$ | $D_2$ | B | $B_1$ | $C_1$ | $C_2$ | r(1) min. | $r_1$(1) min. | $C_r$ | $C_{0r}$ | Open Z · ZZ | Open Z |
| **1** | 3 | 3.8 | — | 1 | — | 0.3 | — | 0.05 | — | 80 | 23 | 130 000 | 150 000 |
| | 4 | 5 | — | 1.6 | — | 0.5 | — | 0.1 | — | 140 | 36 | 100 000 | 120 000 |
| **1.2** | 4 | 4.8 | — | 1.8 | — | 0.4 | — | 0.1 | — | 138 | 35 | 110 000 | 130 000 |
| **1.5** | 4 | 5 | 5 | 1.2 | 2 | 0.4 | 0.6 | 0.05 | 0.05 | 112 | 33 | 100 000 | 120 000 |
| | 5 | 6.5 | 6.5 | 2 | 2.6 | 0.6 | 0.8 | 0.15 | 0.15 | 237 | 69 | 85 000 | 100 000 |
| | 6 | 7.5 | 7.5 | 2.5 | 3 | 0.6 | 0.8 | 0.15 | 0.15 | 330 | 98 | 75 000 | 90 000 |
| **2** | 5 | 6.1 | 6.1 | 1.5 | 2.3 | 0.5 | 0.6 | 0.08 | 0.08 | 169 | 50 | 85 000 | 100 000 |
| | 5 | 6.2 | 6.2 | 2 | 2.5 | 0.6 | 0.6 | 0.1 | 0.1 | 187 | 58 | 85 000 | 100 000 |
| | 6 | 7.5 | 7.5 | 2.3 | 3 | 0.6 | 0.8 | 0.15 | 0.15 | 330 | 98 | 75 000 | 90 000 |
| | 6 | 7.2 | — | 2.5 | — | 0.6 | — | 0.15 | — | 330 | 98 | 75 000 | 90 000 |
| | 7 | 8.2 | 8.2 | 2.5 | 3 | 0.6 | 0.6 | 0.15 | 0.15 | 385 | 127 | 63 000 | 75 000 |
| | 7 | 8.5 | 8.5 | 2.8 | 3.5 | 0.7 | 0.9 | 0.15 | 0.15 | 385 | 127 | 63 000 | 75 000 |
| **2.5** | 6 | 7.1 | 7.1 | 1.8 | 2.6 | 0.5 | 0.8 | 0.08 | 0.08 | 208 | 74 | 71 000 | 80 000 |
| | 7 | 8.5 | 8.5 | 2.5 | 3.5 | 0.7 | 0.9 | 0.15 | 0.15 | 385 | 127 | 63 000 | 75 000 |
| | 8 | 9.2 | — | 2.5 | — | 0.6 | — | 0.2 | — | 560 | 179 | 60 000 | 67 000 |
| | 8 | 9.5 | 9.5 | 2.8 | 4 | 0.7 | 0.9 | 0.15 | 0.15 | 550 | 175 | 60 000 | 71 000 |
| **3** | 6 | 7.2 | 7.2 | 2 | 2.5 | 0.6 | 0.6 | 0.1 | 0.1 | 208 | 74 | 71 000 | 80 000 |
| | 7 | 8.1 | 8.1 | 2 | 3 | 0.5 | 0.8 | 0.1 | 0.1 | 390 | 130 | 63 000 | 75 000 |
| | 8 | 9.2 | — | 2.5 | — | 0.6 | — | 0.15 | — | 560 | 179 | 60 000 | 67 000 |
| | 8 | 9.5 | 9.5 | 3 | 4 | 0.7 | 0.9 | 0.15 | 0.15 | 560 | 179 | 60 000 | 67 000 |
| | 9 | 10.2 | 10.6 | 2.5 | 4 | 0.6 | 0.8 | 0.2 | 0.15 | 570 | 187 | 56 000 | 67 000 |
| | 9 | 10.5 | 10.5 | 3 | 5 | 0.7 | 1 | 0.15 | 0.15 | 570 | 187 | 56 000 | 67 000 |
| | 10 | 11.5 | 11.5 | 4 | 4 | 1 | 1 | 0.15 | 0.15 | 630 | 218 | 50 000 | 60 000 |
| | 13 | 15 | 15 | 5 | 5 | 1 | 1 | 0.2 | 0.2 | 1 300 | 485 | 36 000 | 43 000 |
| **4** | 7 | 8.2 | — | 2 | — | 0.6 | — | 0.1 | — | 310 | 115 | 60 000 | 67 000 |
| | 7 | — | 8.2 | — | 2.5 | — | 0.6 | — | 0.1 | 255 | 107 | 60 000 | 71 000 |
| | 8 | 9.2 | 9.2 | 2 | 3 | 0.6 | 0.6 | 0.15 | 0.1 | 395 | 139 | 56 000 | 67 000 |
| | 9 | 10.3 | 10.3 | 2.5 | 4 | 0.6 | 1 | (0.15) | (0.15) | 640 | 225 | 53 000 | 63 000 |
| | 10 | 11.2 | 11.6 | 3 | 4 | 0.6 | 0.8 | 0.2 | 0.15 | 710 | 270 | 50 000 | 60 000 |
| | 11 | 12.5 | 12.5 | 4 | 4 | 1 | 1 | 0.15 | 0.15 | 960 | 345 | 48 000 | 56 000 |
| | 12 | 13.5 | 13.5 | 4 | 4 | 1 | 1 | 0.2 | 0.2 | 960 | 345 | 48 000 | 56 000 |
| | 13 | 15 | 15 | 5 | 5 | 1 | 1 | 0.2 | 0.2 | 1 300 | 485 | 40 000 | 48 000 |
| | 16 | 18 | 18 | 5 | 5 | 1 | 1 | 0.3 | 0.3 | 1 730 | 670 | 36 000 | 43 000 |

**Note** (1) The values in parentheses are not based on ISO 15.

**Remark** When using bearings with a rotating outer ring, please contact NSK if they are sealed or shielded.

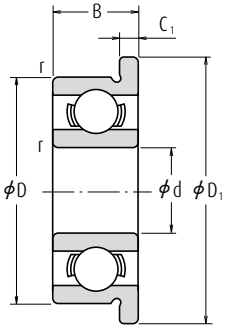



## Radial and axial load factors

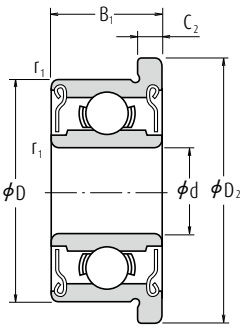
| $C_{or}/F_a$ | $F_a/F_r \leq e$ | | $F_a/F_r > e$ | | e |
|---|---|---|---|---|---|
| | X | Y | X | Y | |
| 5 | 1 | 0 | 0.56 | 1.26 | 0.35 |
| 10 | 1 | 0 | 0.56 | 1.49 | 0.29 |
| 15 | 1 | 0 | 0.56 | 1.64 | 0.27 |
| 20 | 1 | 0 | 0.56 | 1.76 | 0.25 |
| 25 | 1 | 0 | 0.56 | 1.85 | 0.24 |
| 30 | 1 | 0 | 0.56 | 1.92 | 0.23 |
| 50 | 1 | 0 | 0.56 | 2.13 | 0.20 |

| Bearing Numbers | | | | Abutment and Fillet Dimensions (mm) | | | | Mass (g) approx. | |
|---|---|---|---|---|---|---|---|---|---|
| Open | Shielded | Sealed | | $d_a$ min. | $d_b$ max. | $r_a$ max. | $r_b$ max. | Open | Shielded |
| F 681 | — | — | — | 1.4 | — | 0.05 | — | 0.04 | — |
| F 691 | — | — | — | 1.8 | — | 0.1 | — | 0.14 | — |
| MF 41 X | — | — | — | 2.0 | — | 0.1 | — | 0.12 | — |
| F 681 X | F 681 XZZ | — | — | 1.9 | 2.1 | 0.05 | 0.05 | 0.09 | 0.14 |
| F 691 X | F 691 XZZ | — | — | 2.7 | 2.5 | 0.15 | 0.15 | 0.23 | 0.28 |
| F 601 X | F 601 XZZ | — | — | 2.7 | 3.0 | 0.15 | 0.15 | 0.42 | 0.52 |
| F 682 | F 682 ZZ | — | — | 2.6 | 2.7 | 0.08 | 0.08 | 0.16 | 0.22 |
| MF 52 B | MF 52 BZZ | — | — | 2.8 | 2.7 | 0.1 | 0.1 | 0.21 | 0.27 |
| F 692 | F 692 ZZ | — | — | 3.2 | 3.0 | 0.15 | 0.15 | 0.35 | 0.48 |
| MF 62 | — | — | — | 3.2 | — | 0.15 | — | 0.36 | — |
| MF 72 | MF 72 ZZ | — | — | 3.2 | 3.8 | 0.15 | 0.15 | 0.52 | 0.56 |
| F 602 | F 602 ZZ | — | — | 3.2 | 3.1 | 0.15 | 0.15 | 0.60 | 0.71 |
| F 682 X | F 682 XZZ | — | — | 3.1 | 3.7 | 0.08 | 0.08 | 0.25 | 0.36 |
| F 692 X | F 692 XZZ | — | — | 3.7 | 3.8 | 0.15 | 0.15 | 0.51 | 0.68 |
| MF 82 X | — | — | — | 4.1 | — | 0.2 | — | 0.62 | — |
| F 602 X | F 602 XZZ | — | — | 3.7 | 3.5 | 0.15 | 0.15 | 0.74 | 0.98 |
| MF 63 | MF 63 ZZ | — | — | 3.8 | 3.7 | 0.1 | 0.1 | 0.27 | 0.33 |
| F 683 A | F 683 AZZ | — | — | 3.8 | 4.0 | 0.1 | 0.1 | 0.37 | 0.53 |
| MF 83 | — | — | — | 4.2 | — | 0.15 | — | 0.56 | — |
| F 693 | F 693 ZZ | — | — | 4.2 | 4.3 | 0.15 | 0.15 | 0.70 | 0.97 |
| MF 93 | MF 93 ZZ | — | — | 4.6 | 4.3 | 0.2 | 0.15 | 0.81 | 1.34 |
| F 603 | F 603 ZZ | — | — | 4.2 | 4.3 | 0.15 | 0.15 | 1.0 | 1.63 |
| F 623 | F 623 ZZ | — | — | 4.2 | 4.3 | 0.15 | 0.15 | 1.85 | 1.86 |
| F 633 | F 633 ZZ | — | — | 4.6 | 6.0 | 0.2 | 0.2 | 3.73 | 3.59 |
| MF 74 | — | — | — | 4.8 | — | 0.1 | — | 0.29 | — |
| — | MF 74 ZZ | — | — | — | 4.8 | — | 0.1 | — | 0.35 |
| MF 84 | MF 84 ZZ | — | — | 5.2 | 5.0 | 0.15 | 0.1 | 0.44 | 0.63 |
| F 684 | F 684 ZZ | — | — | 4.8 | 5.2 | 0.1 | 0.1 | 0.70 | 1.14 |
| MF 104 B | MF 104 BZZ | — | — | 5.6 | 5.9 | 0.2 | 0.15 | 1.13 | 1.59 |
| F 694 | F 694 ZZ | — | — | 5.2 | 5.6 | 0.15 | 0.15 | 1.91 | 1.96 |
| F 604 | F 604 ZZ | — | — | 5.6 | 5.6 | 0.2 | 0.2 | 2.53 | 2.53 |
| F 624 | F 624 ZZ | — | — | 5.6 | 6.0 | 0.2 | 0.2 | 3.38 | 3.53 |
| F 634 | F 634 ZZ1 | — | — | 6.0 | 7.5 | 0.3 | 0.3 | 5.73 | 5.62 |

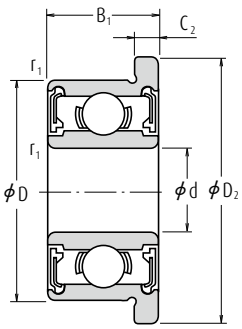
## Metric Design With Flange
## Bore Diameter 5 – 9 mm



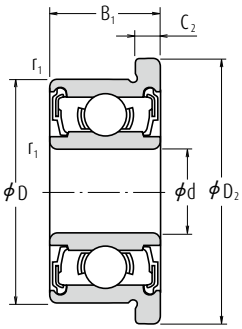

Open Type




Shielded Type
ZZ · ZZ1




Non-Contact
Sealed Type
VV



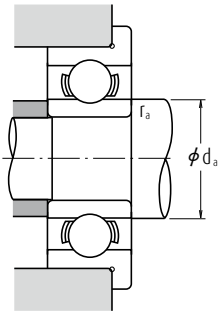

Contact
Sealed Type
DD

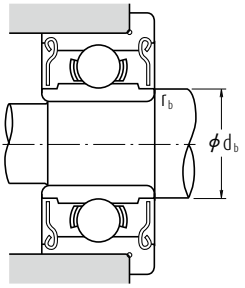
| Boundary Dimensions (mm) | | | | | | | | | | Basic Load Ratings (N) | | Limiting Speeds ($min^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | Grease | | Oil |
| d | D | $D_1$ | $D_2$ | B | $B_1$ | $C_1$ | $C_2$ | r min. | $r_1$ min. | $C_r$ | $C_{0r}$ | Open Z · ZZ V · VV | D · DD | Open Z |
| **5** | 8 | 9.2 | — | 2 | — | 0.6 | — | 0.1 | — | 310 | 120 | 53 000 | — | 63 000 |
| | 8 | — | 9.2 | — | 2.5 | — | 0.6 | — | 0.1 | 278 | 131 | 53 000 | — | 63 000 |
| | 9 | 10.2 | 10.2 | 2.5 | 3 | 0.6 | 0.6 | 0.15 | 0.15 | 430 | 168 | 50 000 | — | 60 000 |
| | 10 | 11.2 | 11.6 | 3 | 4 | 0.6 | 0.8 | 0.15 | 0.15 | 430 | 168 | 50 000 | — | 60 000 |
| | 11 | 12.5 | 12.5 | 3 | 5 | 0.8 | 1 | 0.15 | 0.15 | 715 | 281 | 45 000 | — | 53 000 |
| | 13 | 15 | 15 | 4 | 4 | 1 | 1 | 0.2 | 0.2 | 1 080 | 430 | 43 000 | 40 000 | 50 000 |
| | 14 | 16 | 16 | 5 | 5 | 1 | 1 | 0.2 | 0.2 | 1 330 | 505 | 40 000 | 38 000 | 50 000 |
| | 16 | 18 | 18 | 5 | 5 | 1 | 1 | 0.3 | 0.3 | 1 730 | 670 | 36 000 | 32 000 | 43 000 |
| | 19 | 22 | 22 | 6 | 6 | 1.5 | 1.5 | 0.3 | 0.3 | 2 340 | 885 | 32 000 | 30 000 | 40 000 |
| **6** | 10 | 11.2 | 11.2 | 2.5 | 3 | 0.6 | 0.6 | 0.15 | 0.1 | 495 | 218 | 45 000 | — | 53 000 |
| | 12 | 13.2 | 13.6 | 3 | 4 | 0.6 | 0.8 | 0.2 | 0.15 | 715 | 292 | 43 000 | 40 000 | 50 000 |
| | 13 | 15 | 15 | 3.5 | 5 | 1 | 1.1 | 0.15 | 0.15 | 1 080 | 440 | 40 000 | 38 000 | 50 000 |
| | 15 | 17 | 17 | 5 | 5 | 1.2 | 1.2 | 0.2 | 0.2 | 1 730 | 670 | 40 000 | 36 000 | 45 000 |
| | 17 | 19 | 19 | 6 | 6 | 1.2 | 1.2 | 0.3 | 0.3 | 2 260 | 835 | 38 000 | 34 000 | 45 000 |
| | 19 | 22 | 22 | 6 | 6 | 1.5 | 1.5 | 0.3 | 0.3 | 2 340 | 885 | 32 000 | 30 000 | 40 000 |
| | 22 | 25 | 25 | 7 | 7 | 1.5 | 1.5 | 0.3 | 0.3 | 3 300 | 1 370 | 30 000 | 28 000 | 36 000 |
| **7** | 11 | 12.2 | 12.2 | 2.5 | 3 | 0.6 | 0.6 | 0.15 | 0.1 | 455 | 201 | 43 000 | — | 50 000 |
| | 13 | 14.2 | 14.6 | 3 | 4 | 0.6 | 0.8 | 0.2 | 0.15 | 540 | 276 | 40 000 | — | 48 000 |
| | 14 | 16 | 16 | 3.5 | 5 | 1 | 1.1 | 0.15 | 0.15 | 1 170 | 510 | 40 000 | 34 000 | 45 000 |
| | 17 | 19 | 19 | 5 | 5 | 1.2 | 1.2 | 0.3 | 0.3 | 1 610 | 715 | 36 000 | 28 000 | 43 000 |
| | 19 | 22 | 22 | 6 | 6 | 1.5 | 1.5 | 0.3 | 0.3 | 2 340 | 885 | 36 000 | 32 000 | 43 000 |
| | 22 | 25 | 25 | 7 | 7 | 1.5 | 1.5 | 0.3 | 0.3 | 3 300 | 1 370 | 30 000 | 28 000 | 36 000 |
| **8** | 12 | 13.2 | 13.6 | 2.5 | 3.5 | 0.6 | 0.8 | 0.15 | 0.1 | 545 | 274 | 40 000 | — | 48 000 |
| | 14 | 15.6 | 15.6 | 3.5 | 4 | 0.8 | 0.8 | 0.2 | 0.15 | 820 | 385 | 38 000 | 32 000 | 45 000 |
| | 16 | 18 | 18 | 4 | 5 | 1 | 1.1 | 0.2 | 0.2 | 1 610 | 710 | 36 000 | 30 000 | 43 000 |
| | 19 | 22 | 22 | 6 | 6 | 1.5 | 1.5 | 0.3 | 0.3 | 2 240 | 910 | 36 000 | 28 000 | 43 000 |
| | 22 | 25 | 25 | 7 | 7 | 1.5 | 1.5 | 0.3 | 0.3 | 3 300 | 1 370 | 34 000 | 28 000 | 40 000 |
| **9** | 17 | 19 | 19 | 4 | 5 | 1 | 1.1 | 0.2 | 0.2 | 1 330 | 665 | 36 000 | 24 000 | 43 000 |
| | 20 | 23 | 23 | 6 | 6 | 1.5 | 1.5 | 0.3 | 0.3 | 1 720 | 840 | 34 000 | 24 000 | 40 000 |

**Remark** When using bearings with a rotating outer ring, please contact NSK if they are sealed or shielded.

## Radial and axial load factors

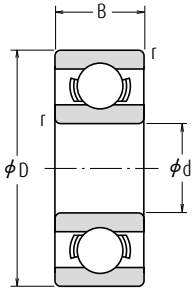
| $C_{or}/F_a$ | $F_a/F_r \leq e$ | | $F_a/F_r > e$ | | e |
|---|---|---|---|---|---|
| | X | Y | X | Y | |
| 5 | 1 | 0 | 0.56 | 1.26 | 0.35 |
| 10 | 1 | 0 | 0.56 | 1.49 | 0.29 |
| 15 | 1 | 0 | 0.56 | 1.64 | 0.27 |
| 20 | 1 | 0 | 0.56 | 1.76 | 0.25 |
| 25 | 1 | 0 | 0.56 | 1.85 | 0.24 |
| 30 | 1 | 0 | 0.56 | 1.92 | 0.23 |
| 50 | 1 | 0 | 0.56 | 2.13 | 0.20 |



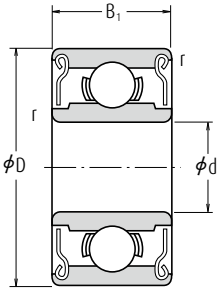




| Bearing Numbers | | | | Abutment and Fillet Dimensions (mm) | | | | Mass (g) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | approx. | |
| Open | Shielded | Sealed | | $d_a$ min. | $d_b$ max. | $r_a$ max. | $r_b$ max. | Open | Shielded |
| MF 85 | — | — | — | 5.8 | — | 0.1 | — | 0.33 | — |
| — | MF 85 ZZ | — | — | — | 5.8 | — | 0.1 | — | 0.41 |
| MF 95 | MF 95 ZZ1 | — | — | 6.2 | 6.0 | 0.15 | 0.15 | 0.59 | 0.66 |
| MF 105 | MF 105 ZZ | — | — | 6.2 | 6.0 | 0.15 | 0.15 | 1.05 | 1.46 |
| F 685 | F 685 ZZ | — | — | 6.2 | 6.2 | 0.15 | 0.15 | 1.37 | 2.18 |
| F 695 | F 695 ZZ | VV | DD | 6.6 | 6.6 | 0.2 | 0.2 | 2.79 | 2.84 |
| F 605 | F 605 ZZ | — | DD | 6.6 | 6.9 | 0.2 | 0.2 | 3.9 | 3.85 |
| F 625 | F 625 ZZ1 | VV | DD | 7.0 | 7.5 | 0.3 | 0.3 | 5.37 | 5.27 |
| F 635 | F 635 ZZ1 | VV | DD | 7.0 | 8.5 | 0.3 | 0.3 | 9.49 | 9.49 |
| MF 106 | MF 106 ZZ1 | — | — | 7.2 | 7.0 | 0.15 | 0.1 | 0.65 | 0.77 |
| MF 126 | MF 126 ZZ | — | DD | 7.6 | 7.2 | 0.2 | 0.15 | 1.38 | 1.94 |
| F 686 A | F 686 AZZ | VV | DD | 7.2 | 7.4 | 0.15 | 0.15 | 2.25 | 3.04 |
| F 696 | F 696 ZZ1 | VV | DD | 7.6 | 7.9 | 0.2 | 0.2 | 4.34 | 4.26 |
| F 606 | F 606 ZZ | VV | DD | 8.0 | 8.2 | 0.3 | 0.3 | 6.58 | 6.61 |
| F 626 | F 626 ZZ1 | VV | DD | 8.0 | 8.5 | 0.3 | 0.3 | 9.09 | 9.09 |
| F 636 | F 636 ZZ | VV | DD | 8.0 | 10.5 | 0.3 | 0.3 | 14.6 | 14.7 |
| MF 117 | MF 117 ZZ | — | — | 8.2 | 8.0 | 0.15 | 0.1 | 0.72 | 0.82 |
| MF 137 | MF 137 ZZ | — | — | 8.6 | 9.0 | 0.2 | 0.15 | 1.7 | 2.23 |
| F 687 | F 687 ZZ1 | VV | DD | 8.2 | 8.5 | 0.15 | 0.15 | 2.48 | 3.37 |
| F 697 | F 697 ZZ1 | VV | DD | 9.0 | 10.2 | 0.3 | 0.3 | 5.65 | 5.65 |
| F 607 | F 607 ZZ1 | VV | DD | 9.0 | 9.1 | 0.3 | 0.3 | 8.66 | 8.66 |
| F 627 | F 627 ZZ | VV | DD | 9.0 | 10.5 | 0.3 | 0.3 | 14.2 | 14.2 |
| MF 128 | MF 128 ZZ1 | — | — | 9.2 | 9.0 | 0.15 | 0.1 | 0.82 | 1.15 |
| MF 148 | MF 148 ZZ | VV | DD | 9.6 | 9.2 | 0.2 | 0.15 | 2.09 | 2.39 |
| F 688 A | F 688 AZZ | VV | DD | 9.6 | 10.2 | 0.2 | 0.2 | 3.54 | 4.47 |
| F 698 | F 698 ZZ | VV | DD | 10.0 | 10.0 | 0.3 | 0.3 | 8.35 | 8.3 |
| F 608 | F 608 ZZ | VV | DD | 10.0 | 10.5 | 0.3 | 0.3 | 13.4 | 13.5 |
| F 689 | F 689 ZZ1 | VV | DD | 10.6 | 11.5 | 0.2 | 0.2 | 3.97 | 4.91 |
| F 699 | F 699 ZZ1 | VV | DD | 11.0 | 12.0 | 0.3 | 0.3 | 9.51 | 9.51 |

## Inch Design
## Bore Diameter 1.016 – 9.525 mm




Open Type



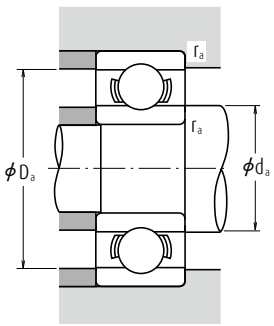

Shielded Type
ZZ · ZZS

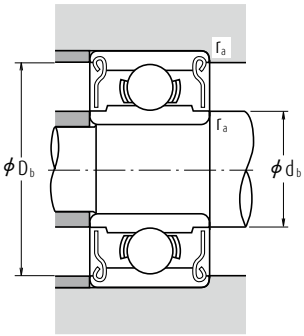
| Boundary Dimensions (mm) | | | | | Basic Load Ratings (N) | | Limiting Speeds (min⁻¹) | | Bearing |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Grease | Oil | |
| d | D | B | $B_1$ | r min. | $C_r$ | $C_{0r}$ | Open Z · ZZ | Open Z | Open |
| **1.016** | 3.175 | 1.191 | — | 0.1 | 80 | 23 | 130 000 | 150 000 | **R 09** |
| **1.191** | 3.967 | 1.588 | 2.380 | 0.1 | 138 | 35 | 110 000 | 130 000 | **R 0** |
| **1.397** | 4.762 | 1.984 | 2.779 | 0.1 | 231 | 66 | 90 000 | 110 000 | **R 1** |
| **1.984** | 6.350 | 2.380 | 3.571 | 0.1 | 310 | 108 | 67 000 | 80 000 | **R 1-4** |
| **2.380** | 4.762 | 1.588 | — | 0.1 | 188 | 60 | 80 000 | 95 000 | **R 133** |
| | 4.762 | — | 2.380 | 0.1 | 143 | 52 | 80 000 | 95 000 | — |
| | 7.938 | 2.779 | 3.571 | 0.15 | 550 | 175 | 60 000 | 71 000 | **R 1-5** |
| **3.175** | 6.350 | 2.380 | 2.779 | 0.1 | 283 | 95 | 67 000 | 80 000 | **R 144** |
| | 7.938 | 2.779 | 3.571 | 0.1 | 560 | 179 | 60 000 | 67 000 | **R 2-5** |
| | 9.525 | 2.779 | 3.571 | 0.15 | 640 | 225 | 53 000 | 63 000 | **R 2-6** |
| | 9.525 | 3.967 | 3.967 | 0.3 | 630 | 218 | 56 000 | 67 000 | **R 2** |
| | 12.700 | 4.366 | 4.366 | 0.3 | 640 | 225 | 53 000 | 63 000 | **R 2A** |
| **3.967** | 7.938 | 2.779 | 3.175 | 0.1 | 360 | 149 | 53 000 | 63 000 | **R 155** |
| **4.762** | 7.938 | 2.779 | 3.175 | 0.1 | 360 | 149 | 53 000 | 63 000 | **R 156** |
| | 9.525 | 3.175 | 3.175 | 0.1 | 710 | 270 | 50 000 | 60 000 | **R 166** |
| | 12.700 | 3.967 | 4.978 | 0.3 | 1 300 | 485 | 43 000 | 53 000 | **R 3** |
| **6.350** | 9.525 | 3.175 | 3.175 | 0.1 | 420 | 204 | 48 000 | 56 000 | **R 168B** |
| | 12.700 | 3.175 | 4.762 | 0.15 | 1 080 | 440 | 40 000 | 50 000 | **R 188** |
| | 15.875 | 4.978 | 4.978 | 0.3 | 1 610 | 660 | 38 000 | 45 000 | **R 4B** |
| | 19.050 | 5.558 | 7.142 | 0.4 | 2 620 | 1 060 | 36 000 | 43 000 | **R 4AA** |
| **7.938** | 12.700 | 3.967 | 3.967 | 0.15 | 540 | 276 | 40 000 | 48 000 | **R 1810** |
| **9.525** | 22.225 | 5.558 | 7.142 | 0.4 | 3 350 | 1 410 | 32 000 | 38 000 | **R 6** |

**Remarks** 1. When using bearings with a rotating outer ring, please contact NSK if they are shielded.
2. Bearings with double shields (ZZ, ZZS) are also available with single shields (Z, ZS).

## Radial and axial load factors

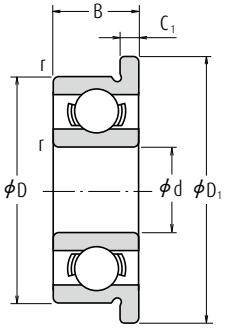
| $C_{or}/F_a$ | $F_a/F_r \leq e$ | | $F_a/F_r > e$ | | e |
|---|---|---|---|---|---|
| | X | Y | X | Y | |
| 5 | 1 | 0 | 0.56 | 1.26 | 0.35 |
| 10 | 1 | 0 | 0.56 | 1.49 | 0.29 |
| 15 | 1 | 0 | 0.56 | 1.64 | 0.27 |
| 20 | 1 | 0 | 0.56 | 1.76 | 0.25 |
| 25 | 1 | 0 | 0.56 | 1.85 | 0.24 |
| 30 | 1 | 0 | 0.56 | 1.92 | 0.23 |
| 50 | 1 | 0 | 0.56 | 2.13 | 0.20 |



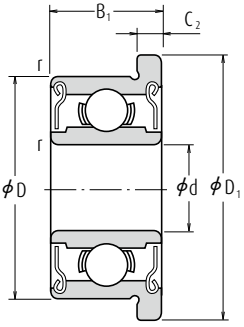




| Numbers | Abutment and Fillet Dimensions (mm) | | | | | Mass (g) | |
|---|---|---|---|---|---|---|---|
| | | | | | | approx. | |
| Shielded | $d_a$ min. | $d_b$ max. | $D_a$ max. | $D_b$ min. | $r_a$ max. | Open | Shielded |
| — | 1.9 | — | 2.3 | — | 0.1 | 0.04 | — |
| **R 0 ZZ** | 2.0 | 1.9 | 3.1 | 3.5 | 0.1 | 0.09 | 0.11 |
| **R 1 ZZ** | 2.2 | 2.3 | 3.9 | 4.1 | 0.1 | 0.15 | 0.19 |
| **R 1-4 ZZ** | 2.8 | 3.9 | 5.5 | 5.9 | 0.1 | 0.35 | 0.50 |
| — | 3.2 | — | 3.9 | — | 0.1 | 0.10 | — |
| **R 133 ZZS** | — | 3.0 | — | 4.2 | 0.1 | — | 0.13 |
| **R 1-5 ZZ** | 3.6 | 4.1 | 6.7 | 7.0 | 0.15 | 0.60 | 0.72 |
| **R 144 ZZ** | 4.0 | 3.9 | 5.5 | 5.9 | 0.1 | 0.25 | 0.27 |
| **R 2-5 ZZ** | 4.0 | 4.3 | 7.1 | 7.3 | 0.1 | 0.55 | 0.72 |
| **R 2-6 ZZS** | 4.4 | 4.6 | 8.3 | 8.2 | 0.15 | 0.96 | 1.13 |
| **R 2 ZZ** | 5.2 | 4.8 | 7.5 | 8.0 | 0.3 | 1.36 | 1.39 |
| **R 2A ZZ** | 5.2 | 4.6 | 10.7 | 8.2 | 0.3 | 3.3 | 3.23 |
| **R 155 ZZS** | 4.8 | 5.5 | 7.1 | 7.3 | 0.1 | 0.51 | 0.56 |
| **R 156 ZZS** | 5.6 | 5.5 | 7.1 | 7.3 | 0.1 | 0.39 | 0.42 |
| **R 166 ZZ** | 5.6 | 5.9 | 8.7 | 8.8 | 0.1 | 0.81 | 0.85 |
| **R 3 ZZ** | 6.8 | 6.5 | 10.7 | 11.2 | 0.3 | 2.21 | 2.79 |
| **R 168 BZZ** | 7.2 | 7.0 | 8.7 | 8.9 | 0.1 | 0.58 | 0.62 |
| **R 188 ZZ** | 7.6 | 7.4 | 11.5 | 11.6 | 0.15 | 1.53 | 2.21 |
| **R 4B ZZ** | 8.4 | 8.4 | 13.8 | 13.8 | 0.3 | 4.5 | 4.43 |
| **R 4AA ZZ** | 9.4 | 9.0 | 16.0 | 16.6 | 0.4 | 7.48 | 9.17 |
| **R 1810 ZZ** | 9.2 | 9.0 | 11.5 | 11.6 | 0.15 | 1.56 | 1.48 |
| **R 6 ZZ** | 12.6 | 11.9 | 19.2 | 20.0 | 0.4 | 9.02 | 11 |

## Inch Design With Flange
## Bore Diameter 1.191 – 9.525 mm



Open Type



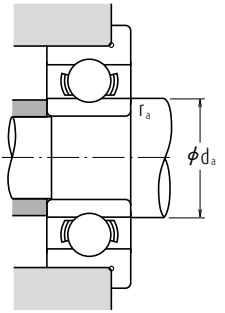
Shielded Type
ZZ · ZZS

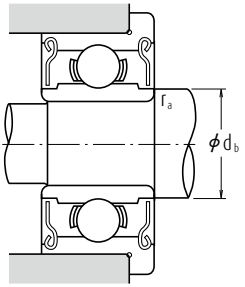
| Boundary Dimensions (mm) | | | | | | | | Basic Load Ratings (N) | |
|---|---|---|---|---|---|---|---|---|---|
| d | D | $D_1$ | B | $B_1$ | $C_1$ | $C_2$ | r min. | $C_r$ | $C_{0r}$ |
| **1.191** | 3.967 | 5.156 | 1.588 | 2.380 | 0.330 | 0.790 | 0.1 | 138 | 35 |
| **1.397** | 4.762 | 5.944 | 1.984 | 2.779 | 0.580 | 0.790 | 0.1 | 231 | 66 |
| **1.984** | 6.350 | 7.518 | 2.380 | 3.571 | 0.580 | 0.790 | 0.1 | 310 | 108 |
| **2.380** | 4.762 | 5.944 | 1.588 | — | 0.460 | — | 0.1 | 188 | 60 |
| | 4.762 | 5.944 | — | 2.380 | — | 0.790 | 0.1 | 143 | 52 |
| | 7.938 | 9.119 | 2.779 | 3.571 | 0.580 | 0.790 | 0.15 | 550 | 175 |
| **3.175** | 6.350 | 7.518 | 2.380 | 2.779 | 0.580 | 0.790 | 0.1 | 283 | 95 |
| | 7.938 | 9.119 | 2.779 | 3.571 | 0.580 | 0.790 | 0.1 | 560 | 179 |
| | 9.525 | 10.719 | 2.779 | 3.571 | 0.580 | 0.790 | 0.15 | 640 | 225 |
| | 9.525 | 11.176 | 3.967 | 3.967 | 0.760 | 0.760 | 0.3 | 630 | 218 |
| **3.967** | 7.938 | 9.119 | 2.779 | 3.175 | 0.580 | 0.910 | 0.1 | 360 | 149 |
| **4.762** | 7.938 | 9.119 | 2.779 | 3.175 | 0.580 | 0.910 | 0.1 | 360 | 149 |
| | 9.525 | 10.719 | 3.175 | 3.175 | 0.580 | 0.790 | 0.1 | 710 | 270 |
| | 12.700 | 14.351 | 4.978 | 4.978 | 1.070 | 1.070 | 0.3 | 1 300 | 485 |
| **6.350** | 9.525 | 10.719 | 3.175 | 3.175 | 0.580 | 0.910 | 0.1 | 420 | 204 |
| | 12.700 | 13.894 | 3.175 | 4.762 | 0.580 | 1.140 | 0.15 | 1 080 | 440 |
| | 15.875 | 17.526 | 4.978 | 4.978 | 1.070 | 1.070 | 0.3 | 1 610 | 660 |
| **7.938** | 12.700 | 13.894 | 3.967 | 3.967 | 0.790 | 0.790 | 0.15 | 540 | 276 |
| **9.525** | 22.225 | 24.613 | 7.142 | 7.142 | 1.570 | 1.570 | 0.4 | 3 350 | 1 410 |

**Remarks** 1. When using bearings with a rotating outer ring, please contact NSK if they are shielded.
2. Bearings with double shields (ZZ, ZZS) are also available with single shields (Z, ZS).

## Radial and axial load factors

| $C_{or}/F_a$ | $F_a/F_r \leq e$ | | $F_a/F_r > e$ | | e |
|---|---|---|---|---|---|
| | X | Y | X | Y | |
| 5 | 1 | 0 | 0.56 | 1.26 | 0.35 |
| 10 | 1 | 0 | 0.56 | 1.49 | 0.29 |
| 15 | 1 | 0 | 0.56 | 1.64 | 0.27 |
| 20 | 1 | 0 | 0.56 | 1.76 | 0.25 |
| 25 | 1 | 0 | 0.56 | 1.85 | 0.24 |
| 30 | 1 | 0 | 0.56 | 1.92 | 0.23 |
| 50 | 1 | 0 | 0.56 | 2.13 | 0.20 |




| Limiting Speeds ($min^{-1}$) | | Bearing Numbers | | Abutment and Fillet Dimensions (mm) | | | Mass (g) | |
|---|---|---|---|---|---|---|---|---|
| Grease | Oil | | | | | | approx. | |
| Open Z · ZZ | Open Z | Open | Shielded | $d_a$ min. | $d_b$ max. | $r_a$ max. | Open | Shielded |
| 110 000 | 130 000 | **FR 0** | **FR 0 ZZ** | 2.0 | 1.9 | 0.1 | 0.11 | 0.16 |
| 90 000 | 110 000 | **FR 1** | **FR 1 ZZ** | 2.2 | 2.3 | 0.1 | 0.20 | 0.25 |
| 67 000 | 80 000 | **FR 1-4** | **FR 1-4 ZZ** | 2.8 | 3.9 | 0.1 | 0.41 | 0.58 |
| 80 000 | 95 000 | **FR 133** | — | 3.2 | — | 0.1 | 0.13 | — |
| 80 000 | 95 000 | — | **FR 133 ZZS** | — | 3.0 | 0.1 | — | 0.19 |
| 60 000 | 71 000 | **FR 1-5** | **FR 1-5 ZZ** | 3.6 | 4.1 | 0.15 | 0.68 | 0.82 |
| 67 000 | 80 000 | **FR 144** | **FR 144 ZZ** | 4.0 | 3.9 | 0.1 | 0.31 | 0.35 |
| 60 000 | 67 000 | **FR 2-5** | **FR 2-5 ZZ** | 4.0 | 4.3 | 0.1 | 0.62 | 0.81 |
| 53 000 | 63 000 | **FR 2-6** | **FR 2-6 ZZS** | 4.4 | 4.6 | 0.15 | 1.04 | 1.25 |
| 56 000 | 67 000 | **FR 2** | **FR 2 ZZ** | 5.2 | 4.8 | 0.3 | 1.51 | 1.55 |
| 53 000 | 63 000 | **FR 155** | **FR 155 ZZS** | 4.8 | 5.5 | 0.1 | 0.59 | 0.67 |
| 53 000 | 63 000 | **FR 156** | **FR 156 ZZS** | 5.6 | 5.5 | 0.1 | 0.47 | 0.53 |
| 50 000 | 60 000 | **FR 166** | **FR 166 ZZ** | 5.6 | 5.9 | 0.1 | 0.90 | 0.98 |
| 43 000 | 53 000 | **FR 3** | **FR 3 ZZ** | 6.8 | 6.5 | 0.3 | 2.97 | 3.09 |
| 48 000 | 56 000 | **FR 168B** | **FR 168 BZZ** | 7.2 | 7.0 | 0.1 | 0.66 | 0.75 |
| 40 000 | 50 000 | **FR 188** | **FR 188 ZZ** | 7.6 | 7.4 | 0.15 | 1.64 | 2.49 |
| 38 000 | 45 000 | **FR 4B** | **FR 4B ZZ** | 8.4 | 8.4 | 0.3 | 4.78 | 4.78 |
| 40 000 | 48 000 | **FR 1810** | **FR 1810 ZZ** | 9.2 | 9.0 | 0.15 | 1.71 | 1.63 |
| 32 000 | 38 000 | **FR 6** | **FR 6 ZZ** | 12.6 | 11.9 | 0.4 | 10.1 | 12.1 |


NSK

## 3. ANGULAR CONTACT BALL BEARINGS


Page

INTRODUCTION ..... B 074


## TECHNICAL DATA


Page

Free Space of Angular Contact Ball Bearings ..... B 080

Dynamic Equivalent Load of Triplex Angular Contact Ball Bearings ..... B 082

Angular Clearances in Double-Row Angular Contact Ball Bearings ..... B 084

Relationship between Radial and Axial Clearances in Double-Row Angular Contact Ball Bearings ..... B 086


## BEARINGS TABLE

### SINGLE-ROW AND MATCHED ANGULAR CONTACT BALL BEARINGS


Bore Dia. Page

10 – 200 mm ..... B 088


### DOUBLE-ROW ANGULAR CONTACT BALL BEARINGS


Bore Dia. Page

10 – 85 mm ..... B 108


### PULLEYS


Bore Dia. Page

10 – 35 mm ..... B 112

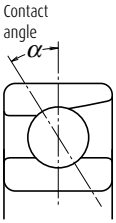

### FOUR-POINT CONTACT BALL BEARINGS


Bore Dia. Page

30 – 200 mm ..... B 114

## DESIGN, TYPES, AND FEATURES

### SINGLE-ROW ANGULAR CONTACT BALL BEARINGS




Since these bearings have a contact angle, they can sustain significant axial loads in one direction together with radial loads. Because of their design, when a radial load is applied, an axial force component is produced; therefore, two opposed bearings or a combination of more than two must be used.

Since the rigidity of single-row angular contact ball bearings can be increased by preloading, they are often used in the main spindles of machine tools, for which high running accuracy is required. (Refer to Chapter 9, Preload, Page A192

Usually, the cages for angular contact ball bearings with a contact angle of 30° (Symbol **A**) or 40° (Symbol **B**) are in accordance with Table 1,but depending on the application, machined synthetic resin cages or molded polyamide resin cages are also used. The basic load ratings given in the bearing tables are based on the cage classification listed in Table 1.

Though the figures in the bearing tables (Pages B086 to B101; bearing bore diameters of 10 to 120) show bearings with single-shoulder-type inner rings, both-shoulder-type bearings are also available. Please consult NSK for more detailed information.

### Double Row Angular Contact Ball Bearings (BTNG Design) & Pulleys Lubrication

NSK supplies pulleys filled with grease at the factory. This is a high-quality lithiumbased grease with an admissible temperature range of −30 °C to +110 °C. The grease used by NSK is compatible with all other mineraloil- based greases. The inner rings of the pulleys are provided with a lubrication hole so that bearings can be re-lubricated. With Version 2RSR, the grease must be pressed in slowly to avoid damaging the seals.

### Pulleys
### Bearing load capacity

If the pulley is supported by a flat contact surface, only a small surface area of the outer ring of the pulleys comes into contact with the rolling plane. The elastic deformation of the outer ring reduces the load-bearing capacity of the pulley. In this case, the values specified in the "Pulley load ratings" table must be used in the calculation. On the other hand, when installing the pulley in a housing bore, the "Bearing load ratings" apply which are also listed.

Table 1 Features of Single-Row Angular Contact Ball Bearings

| Cage Spec. | Material / Method / Symbols | Steel pressed W | Nylon 46 Molded TYN | Nylon 46 Molded T85 | L-PPS resin Molded T7 | Brass machined Omitted | Brass machined MR |
|---|---|---|---|---|---|---|---|
| Features | High Load Capacity | ◎ | ○ | ◎ | ◎ | ○ | ◎ |
| | High-Speed | △ | ◎ | ○ | ○ | △ | ○ |
| | High-Temperature | ◎ | △ | △ | ◎ | ◎ | ◎ |
| | Vibration | △ | △ | △ | △ | ◎ | ◎ |

In addition, for bearings with the same serial number, if the type of cages are different, the number of balls may also be different. In such a case, the load rating will differ from the one listed in the bearing tables.

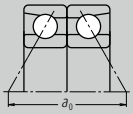
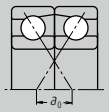
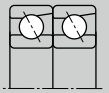
Angular Contact Ball Bearings with contact angles of 15° (Symbol **C**) and 25° (Symbol **A5**) are primarily for high precision or high speed applications, and molded polyamide cages (Symbol TYN) or machined brass cages or synthetic resin cages (Symbol T) are used.

The maximum operating temperature of molded polyamide cages is 150°C.

## MATCHED ANGULAR CONTACT BALL BEARINGS

The types and features of matched angular contact ball bearings are shown in Table 2.

Table 2 Types and Features of Matched Angular Contact Ball Bearings

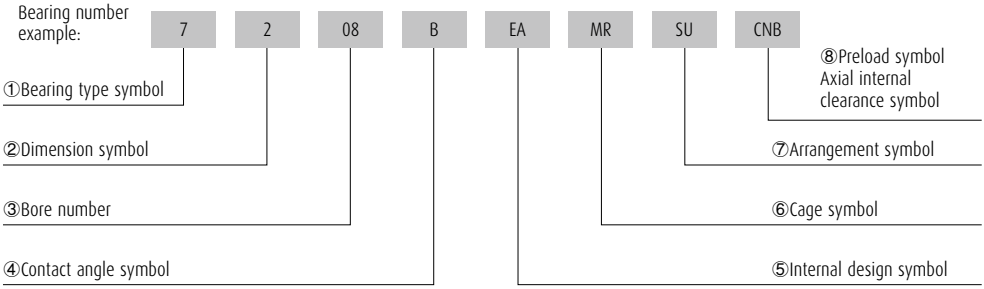
| Figure | Arrangement | Features |
|---|---|---|
|  | Back-to-back (DB) (Example) 7208 A DB | Radial loads and axial loads in both directions can be sustained. Since the distance between the effective load centers $a_0$ is big, this type is suitable if moments are applied. |
|  | Face-to-face (DF) (Example) 7208 B DF | Radial loads and axial loads in both directions can be sustained. Compared with the DB Type, the distance between the effective load centers is small, so the capacity to sustain moments is inferior to the DB Type. |
|  | Tandem (DT) (Example) 7208 A DT | Radial loads and axial loads in one direction can be sustained. Since two bearings share the axial load, this arrangement is used when the load in one direction is heavy. |

## NSKHPS™ ANGULAR CONTACT BALL BEARINGS

In comparison with standard angular contact ball bearings, these bearings have high capacity, high limiting speed, and highly accurate universal matching as the features. The molded polyamide cages are standard specification for the HPS type.

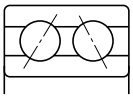
## ☐ Formulation of Bearing Numbers

**Single-Row Angular Contact Ball Bearings Matched Angular Contact Ball Bearings**




| | |
|---|---|
| ①Bearing type symbol | 7 : Single-Row Angular Contact Ball Bearings, Matched Angular Contact Ball Bearings |
| ②Dimension symbol | 2 : 02 Series, 3 : 03 Series, 9 : 19 Series, 0 : 10 Series |
| ③Bore number | Less than 03, Bearing bore 00 : 10mm, 01 : 12mm, 02 : 15mm, 03 : 17mm<br>Over 04, Bearing bore Bore number ×5 (mm) |
| ④Contact angle symbol | C : 15°, A5 : 25°, A : 30°, B : 40° |
| ⑤Internal design symbol | EA : High Load Capacity |
| ⑥Cage symbol | W : Pressed Steel Cage, MR : Machined Brass Cage (Ball guided),<br>No symbol : Machined Brass Cage (Outer Ring guided), TYN : Polyamide Resin Cage,<br>T85 : Polyamide 46 Resin Cage, T7 : L-PPS Resin Cage |
| ⑦Arrangement symbol | SU: Universal arrangement (Single row), DU : Universal arrangement (Double row),<br>DB : Back-to-back arrangement, DF : Face-to-face arrangement, DT : Tandem arrangement |
| ⑧Preload symbol | EL : Extra light preload, L : Light preload, M : Medium preload, H : Heavy preload |
| Axial internal clearance symbol | Omitted : CN clearance, C3 : Clearance greater than CN, C4 : Clearance greater than C3,<br>CNB : CN Clearance equivalent (Universal arrangement) |

### DOUBLE-ROW ANGULAR CONTACT BALL BEARINGS

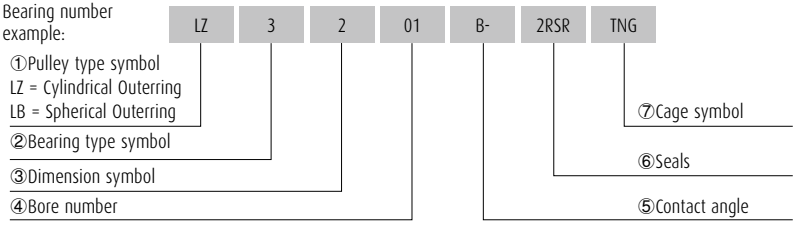


This is basically a back-to-back mounting of two single-row angular contact ball bearings, but their inner and outer rings are each integrated into one. Axial loads in both directions can be sustained, and the capacity to sustain moments is good. This type is used as fixed-end bearings.

Their cages are pressed steel.

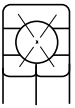
## ☐ Formulation of Bearing Numbers

**Double-Row Angular Contact Ball Bearings**




| | |
|---|---|
| ①Pulley type symbol | |
| ②Bearing type symbol | 5 : Double-Row Angular Contact Ball Bearings |
| ③Dimension symbol | 2 : 02 Series |
| ④Bore number | Less than 03, Bearing bore 00 : 10mm, 01 : 12mm, 02 : 15mm, 03 : 17mm<br>Over 04, Bearing bore Bore number ×5 (mm) |
| ⑤Contact angle | B = 25° |
| ⑥Seals | 2RSR = Seals: 2ZR = Shields |
| ⑦Cage symbol | TNG Polyamid Cage Nylon 66 |

### FOUR-POINT CONTACT BALL BEARINGS



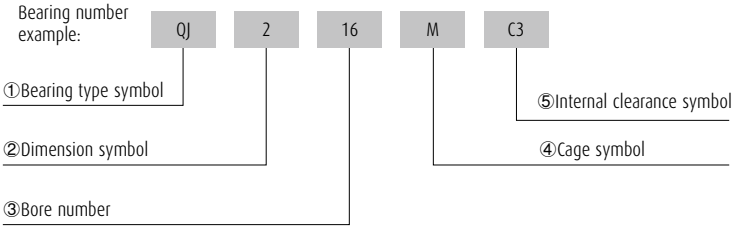
The inner ring is split radially into two pieces. Their design allows one bearing to sustain significant axial loads in either direction.

The contact angle is 35°, so the axial load capacity is high. This type is suitable for carrying pure axial loads or combined loads where the axial loads are high.

The cages are made of machined brass.

## ☐ Formulation of Bearing Numbers

**Four-Point Contact Ball Bearings**




| | |
|---|---|
| ①Bearing type symbol | QJ : Four-Point Contact Ball Bearings |
| ②Dimension symbol | 10 : 10 Series, 2 : 02 Series, 3 : 03 Series |
| ③Bore number | Less than 03, Bearing bore 00 : 10mm, 01 : 12mm, 02 : 15mm, 03 : 17mm<br>Over 04, Bearing bore Bore number ×5 (mm) |
| ④Cage symbol | M : Machined Brass Cage |
| ⑤Internal clearance symbol | C2 : Clearance less than CN, Omitted : CN clearance,<br>C3 : Clearance greater than CN, C4 : Clearance greater than C3 |

## PRECAUTIONS FOR USE OF ANGULAR CONTACT BALL BEARINGS

Under severe operating conditions where the speed and temperature are close to their limits, lubrication is marginal, vibration and moment loads are heavy, they may not be suitable, particularly for certain types of cages. In such a case, please consult with NSK beforehand.

And if the load on angular contact ball bearings becomes too small, or if the ratio of the axial and radial loads for matched bearings exceeds 'e' (e is listed in the bearings tables) during operation, slippage occurs between the balls and raceways, which may result in smearing. Especially with large bearings since the weight of the balls and cage is high. If such load conditions are expected, please consult with NSK for selection of the bearings.

## TOLERANCES AND RUNNING ACCURACY


| | Tables | Pages |
|---|---|---|
| Single-Row Angular Contact Ball Bearings | 7.2 | A128 to A131 |
| NSKHPS Angular Contact Ball Bearings<br>Tolerance for Dimensions: Class 6, Running Accuracy: Class 5 | 7.2 | A128 to A131 |
| Matched Angular Contact Ball Bearings | 7.2 | A128 to A131 |
| Double-Row Angular Contact Ball Bearings | 7.2 | A128 to A131 |
| Four-Point Contact Ball Bearings | 7.2 | A128 to A131 |


## RECOMMENDED FITS


| | Tables | Page |
|---|---|---|
| Single-Row Angular Contact Ball Bearings and HPS Angular Contact Ball Bearings | 8.3 | A164 |
| | 8.5 | A165 |
| Matched Angular Contact Ball Bearings | 8.3 | A164 |
| | 8.5 | A165 |
| Double-Row Angular Contact Ball Bearings | 8.3 | A164 |
| | 8.5 | A165 |
| Four-Point Contact Ball Bearings | 8.3 | A164 |
| | 8.5 | A165 |

## INTERNAL CLEARANCE


| | Table | Page |
|---|---|---|
| Matched Angular Contact Ball Bearings | 8.18 | A174 |


Matched angular contact ball bearings with precision better than P5 are primarily used in the main spindles of machine tools, so they are used with a preload for rigidity. For convenience of selection, internal clearance are adjusted to produce Very Light, Light, Medium, and Heavy Preloads. Their fitting is also special. Concerning these matters, please refer to Tables 9.1 and 9.5 (Pages A194 and A197).

The clearance (or preload) of matched bearings is obtained by axially tightening a pair of bearings till the side faces of their inner or outer rings are pressed against each other.

### NSKHPS Angular Contact Ball Bearings

### Axial Internal Clearance (Measured Clearance)

Units : μm

| Nominal Bore Diameter d (mm) | | Axial Internal Clearance | | | |
|---|---|---|---|---|---|
| | | CNB | | GA | |
| over | incl. | min. | max. | min. | max. |
| 12 | 18 | 17 | 25 | | |
| 18 | 30 | 20 | 28 | −2 | 6 |
| 30 | 50 | 24 | 32 | | |
| 50 | 80 | 29 | 41 | −3 | 9 |

Double-Row Angular Contact Ball Bearings

For the clearance in double-row angular contact ball bearings, please consult with NSK.


| | Table | Page |
|---|---|---|
| Four-Point Contact Ball Bearings | 8.19 | A174 |


## LIMITING SPEEDS (Grease/Oil)

In cases of single-row and matched angular contact ball bearings, The limiting speeds (grease) and limiting speeds (oil) listed in the bearing table are for bearings with standard cage. For those with option cages, limiting speeds (grease/oil) may differ depending on cages. Please consult with NSK. For example, limiting speeds (grease/oil) of machined cage (No symbol) is 1.25 times higher than pressed cage. The limiting speeds of bearings with contact angles of 15° (Symbol C) and 25° (Symbol A5) are for bearings with precision of P5 and better (with machined synthetic-resin cages (T) or molded polyamide cages (TYN)). The limiting speeds listed in the bearing tables should be adjusted depending on the bearing load conditions. Also, higher speeds are attainable by making changes in the lubrication method, cage design, etc. Refer to Page A098 for detailed information.

## TECHNICAL DATA

### Free Space of Angular Contact Ball Bearings

Angular contact ball bearings are used in various components, such as spindles of machine tools, vertical pump motors, and worm gear reducers. This kind of bearing is used mostly with grease lubrication. But such grease lubrication may affect the bearing in terms of temperature rise or durability. To allow a bearing to demonstrate its full performance, it is essential to fill the bearing with the proper amount of a suitable grease. A prerequisite for this job is a knowledge of the bearing's free space.

The angular ball bearing is available in various kinds which are independent of the combinations of bearing series, contact angle, and cage type. The free space of the bearings used most frequently is described below. Table 1 shows the free space of a bearing with a pressed cage for general use and Table 2 shows that of a bearing with a high-tension brass machined cage.

The contact angle symbols A, B, and C in each table refer to the nominal contact angles of 30°, 40°, and 15° of each bearing.

**Table 1 Free Space of Angular Contact Ball Bearing (1) (With Pressed Steel Cage)**

Units: $cm^3$

| Bearing bore No. | Bearing free space | | | |
|---|---|---|---|---|
| | Bearing series – Contact angle symbol | | | |
| | 72-A | 72-B | 73-A | 73-B |
| 00 | 1.5 | 1.4 | 2.9 | 2.8 |
| 01 | 2.1 | 2.0 | 3.7 | 3.5 |
| 02 | 2.8 | 2.7 | 4.8 | 4.6 |
| | | | | |
| 03 | 3.7 | 3.6 | 6.2 | 5.9 |
| 04 | 6.2 | 5.9 | 8.4 | 8.0 |
| 05 | 7.8 | 7.4 | 13 | 12 |
| | | | | |
| 06 | 12 | 11 | 20 | 19 |
| 07 | 16 | 15 | 26 | 24 |
| 08 | 20 | 19 | 36 | 34 |
| | | | | |
| 09 | 25 | 24 | 48 | 45 |
| 10 | 28 | 27 | 63 | 60 |

## Table 2 Free Space of Angular Contact Ball Bearing (2) (With High-Tension Brass Machined Cage)

Units: $cm^3$

| Bearing bore No. | Bearing free space | | | | |
|---|---|---|---|---|---|
| | Bearing series – Contact angle symbol | | | | |
| | 70-C | 72-A<br>72-C | 72-B | 73-A<br>73-C | 73-B |
| 00 | 0.9 | 1.0 | 1.0 | 2.2 | 2.1 |
| 01 | 0.9 | 1.6 | 1.6 | 2.5 | 2.5 |
| 02 | 1.2 | 1.9 | 1.9 | 3.4 | 3.3 |
| | | | | | |
| 03 | 1.6 | 2.7 | 2.7 | 4.6 | 4.4 |
| 04 | 3.0 | 4.7 | 4.2 | 6.1 | 5.9 |
| 05 | 3.5 | 6.0 | 5.3 | 9.2 | 9.0 |
| | | | | | |
| 06 | 4.3 | 8.5 | 8.1 | 14 | 13 |
| 07 | 6.5 | 12 | 11 | 18 | 17 |
| 08 | 8.3 | 14 | 14 | 25 | 24 |
| | | | | | |
| 09 | 10 | 18 | 17 | 34 | 33 |
| 10 | 11 | 20 | 20 | 45 | 44 |
| 11 | 16 | 26 | 25 | 57 | 55 |
| | | | | | |
| 12 | 17 | 33 | 31 | 71 | 69 |
| 13 | 18 | 38 | 37 | 87 | 83 |
| 14 | 24 | 43 | 42 | 107 | 103 |
| | | | | | |
| 15 | 24 | 47 | 45 | 129 | 123 |
| 16 | 34 | 58 | 57 | 152 | 146 |
| 17 | 37 | 71 | 70 | 179 | 172 |
| | | | | | |
| 18 | 44 | 88 | 85 | 207 | 201 |
| 19 | 44 | 105 | 105 | 261 | 244 |
| 20 | 47 | 127 | 127 | 282 | 278 |

## Dynamic Equivalent Load of Triplex Angular Contact Ball Bearings

Three separate single-row bearings may be used side by side as shown in the figure when angular contact ball bearings are to be used to carry a large axial load. There are three patterns of combination, which are expressed by combination symbols of DBD, DFD, and DTD.

As in the case of single-row and double-row bearings, the dynamic equivalent load, which is determined from the radial and axial loads acting on a bearing, is used to calculate the fatigue life for these combined bearings.

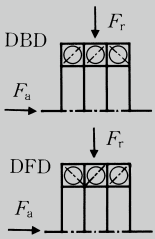
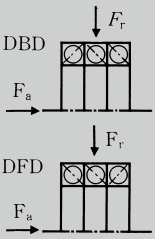
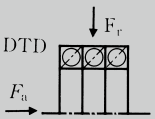
Assuming the dynamic equivalent radial load as $P_r$, the radial load as $F_r$, and axial load as $F_a$, the relationship between the dynamic equivalent radial load and bearing load may be approximated as follows:

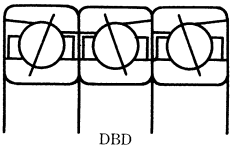
$$P_r = XF_r + YF_a \quad \cdots\cdots (1)$$

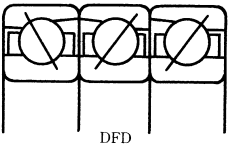
where, X : Radial load factor } See Table 1
Y : Axial load factor }

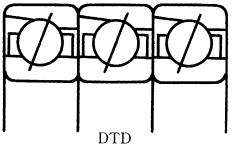
The axial load factor varies with the contact angle. In an angular contact ball bearing, whose contact angle is small, the contact angle varies substantially when the axial load increases.

A change in the contact angle can be expressed by the ratio between the basic static load rating $C_{0r}$ and axial load $F_a$. Accordingly, for the angular contact ball bearing with a contact angle of 15°, the axial load factor at a contact angle corresponding to this ratio is shown. If the angular contact ball bearings have contact angles of 25°, 30° and 40°, the effect of change in the contact angle on the axial load factor may be ignored and thus the axial load factor is assumed as constant.

| Arrangement | Load direction |
|---|---|
| 3 row matched stack, axial load is supported by 2 rows. (Symbol DBD or DFD) |   |
| 3 row matched stack, axial load is supported by 1 row. (Symbol DBD or DFD) |   |
| 3 row tandem matched stack (Symbol DTD) |   |


DBD


DFD


DTD

## Table 1 Factors X and Y of Triplex Angular Contact Ball Bearing

| Contact angle a | j | $\frac{C_{0r}}{jF_a}$ | $\frac{F_a}{F_r} \leqq e$ | | $\frac{F_a}{F} > e$ | | e | Basic load rating of 3 row ball bearings | |
|---|---|---|---|---|---|---|---|---|---|
| | | | X | Y | X | Y | | $C_r$ | $C_{0r}$ |
| 15° | 1.5 | 5 | 1 | 0.64 | 0.58 | 1.46 | 0.51 | 2.16 times of single bearing | 3 times of single bearing |
| 15° | 1.5 | 10 | 1 | 0.70 | 0.58 | 1.61 | 0.47 | | |
| 15° | 1.5 | 15 | 1 | 0.74 | 0.58 | 1.70 | 0.44 | | |
| 15° | 1.5 | 20 | 1 | 0.76 | 0.58 | 1.75 | 0.42 | | |
| 15° | 1.5 | 25 | 1 | 0.78 | 0.58 | 1.81 | 0.41 | | |
| 15° | 1.5 | 30 | 1 | 0.80 | 0.58 | 1.83 | 0.40 | | |
| 15° | 1.5 | 50 | 1 | 0.83 | 0.58 | 1.91 | 0.39 | | |
| 25° | — | — | 1 | 0.48 | 0.54 | 1.16 | 0.68 | | |
| 30° | — | — | 1 | 0.41 | 0.52 | 1.01 | 0.80 | | |
| 40° | — | — | 1 | 0.29 | 0.46 | 0.76 | 1.14 | | |
| 15° | 3 | 5 | 1 | 2.28 | 0.95 | 2.37 | 0.51 | 2.16 times of single bearing | 3 times of single bearing |
| 15° | 3 | 10 | 1 | 2.51 | 0.95 | 2.61 | 0.47 | | |
| 15° | 3 | 15 | 1 | 2.64 | 0.95 | 2.76 | 0.44 | | |
| 15° | 3 | 20 | 1 | 2.73 | 0.95 | 2.85 | 0.42 | | |
| 15° | 3 | 25 | 1 | 2.80 | 0.95 | 2.93 | 0.41 | | |
| 15° | 3 | 30 | 1 | 2.85 | 0.95 | 2.98 | 0.40 | | |
| 15° | 3 | 50 | 1 | 2.98 | 0.95 | 3.11 | 0.39 | | |
| 25° | — | — | 1 | 1.70 | 0.88 | 1.88 | 0.68 | | |
| 30° | — | — | 1 | 1.45 | 0.84 | 1.64 | 0.80 | | |
| 40° | — | — | 1 | 1.02 | 0.76 | 1.23 | 1.14 | | |
| 15° | 1 | 5 | 1 | 0 | 0.44 | 1.10 | 0.51 | 2.16 times of single bearing | 3 times of single bearing |
| 15° | 1 | 10 | 1 | 0 | 0.44 | 1.21 | 0.47 | | |
| 15° | 1 | 15 | 1 | 0 | 0.44 | 1.28 | 0.44 | | |
| 15° | 1 | 20 | 1 | 0 | 0.44 | 1.32 | 0.42 | | |
| 15° | 1 | 25 | 1 | 0 | 0.44 | 1.36 | 0.41 | | |
| 15° | 1 | 30 | 1 | 0 | 0.44 | 1.38 | 0.40 | | |
| 15° | 1 | 50 | 1 | 0 | 0.44 | 1.44 | 0.39 | | |
| 25° | — | — | 1 | 0 | 0.41 | 0.87 | 0.68 | | |
| 30° | — | — | 1 | 0 | 0.39 | 0.76 | 0.80 | | |
| 40° | — | — | 1 | 0 | 0.35 | 0.57 | 1.14 | | |

## Angular Clearances in Double-Row Angular Contact Ball Bearings

The angular clearance in double-row bearings is defined in exactly the same way as for single-row bearings; i.e., with one of the bearing rings fixed, the angular clearance is the greatest possible angular displacement of the axis of the other ring.

Since the angular clearance is the greatest total relative displacement of the two ring axes, it is twice the possible angle of inner and outer ring movement (the maximum angular displacement in one direction from the center without creating a moment).

The relationship between axial and angular clearance for double-row angular contact ball bearings is given by Equation (1) below.

$$\Delta_a = 2m_0 \left\{ \sin\alpha_0 + \frac{\theta R_i}{2m_0} \sqrt{1 - \left( \cos\alpha_0 + \frac{\theta l}{4m_0} \right)^2} \right\} \quad \cdots\cdots (1)$$

where,

$\Delta_a$ : Axial clearance (mm)

$m_0$ : Distance between inner and outer ring groove curvature centers, $m_0 = r_e + r_i - D_w$ (mm)

$r_e$ : Outer-ring groove radius (mm)

$r_i$ : Inner-ring groove radius (mm)

$\alpha_0$ : Initial contact angle (°)

$\theta$ : Angular clearance (rad)

$R_i$ : Distance between shaft center and inner-ring groove curvature center (mm)

$l$ : Distance between left and right groove centers of inner-ring (mm)

The above equation is shown plotted in Fig. 1 for NSK double-row angular contact ball bearings series 52, 53, 32, and 33.

The relationship between radial clearance $\Delta_r$ and axial clearance $\Delta_a$ for double-row angular contact ball bearings was explained in pages B086 and B087. Based on those equations, Fig. 2 shows the relationship between angular clearance $\theta$ and radial clearance $\Delta_r$.

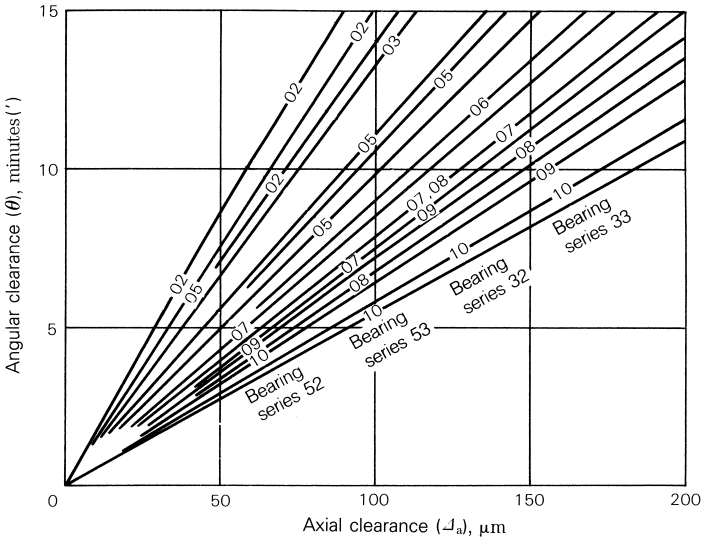



Fig. 1 Relationship between Axial and Angular Clearances

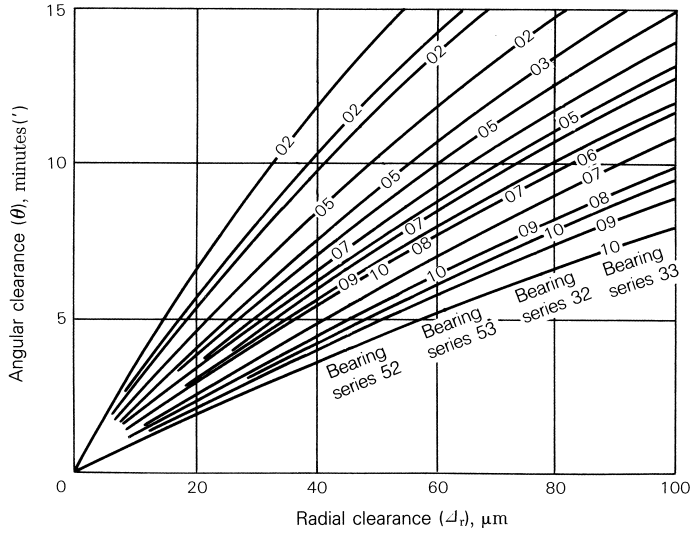



Fig. 2 Relationship between Radial and Angular Clearances

## Relationship between Radial and Axial Clearances in Double-Row Angular Contact Ball Bearings

The relationship between the radial and axial internal clearances in double-row angular contact ball bearings can be determined geometrically as shown in Fig. 1 below.

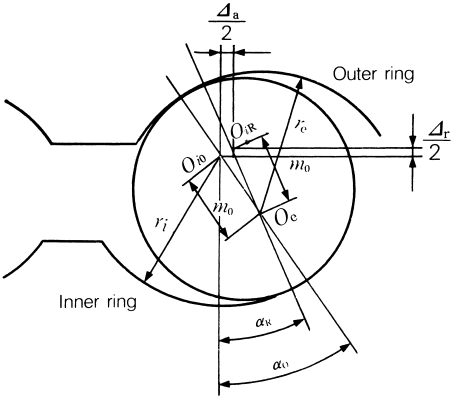



Fig. 1

where, $\Delta_r$ : Radial clearance (mm)
$\Delta_a$ : Axial clearance (mm)
$a_0$ : Initial contact angle, inner or outer ring displaced axially
$a_R$ : Initial contact angle, inner or outer ring displaced radially
$O_e$ : Center of outer-ring groove curvature (outer ring fixed)
$O_{i0}$ : Center of inner-ring groove curvature (inner ring displaced axially)
$O_{iR}$ : Center of inner-ring groove curvature (inner ring displaced radially)
$m_0$ : Distance between inner and outer ring groove-curvature centers, $m_0=r_i+r_e-D_w$
$D_w$ : Ball diameter (mm)
$r_i$ : Radius of inner-ring groove (mm)
$r_e$ : Radius of outer-ring groove (mm)

The following relations can be derived from Fig. 1:

$$m_0 \sin a_0 = m_0 \sin a_R + \frac{\Delta_a}{2} \quad \cdots\cdots (1)$$

$$m_0 \cos a_0 = m_0 \cos a_R + \frac{\Delta_r}{2} \quad \cdots\cdots (2)$$

since $\sin^2 a_0 = 1 - \cos^2 a_0$,

$$(m_0 \sin a_0)^2 = m_0^2 - (m_0 \cos a_0)^2 \quad \cdots\cdots (3)$$

Combined Equations (1), (2), and (3), we obtain:

$$\left(m_0 \sin a_R + \frac{\Delta_a}{2}\right)^2 = m_0^2 - \left(m_0 \cos a_R - \frac{\Delta_r}{2}\right)^2 \quad \cdots\cdots (4)$$

$$\Delta_a = 2\sqrt{m_0^2 - \left(m_0 \cos a_R - \frac{\Delta_r}{2}\right)^2} - 2m_0 \sin a_R \quad \cdots\cdots (5)$$

$a_R$ is 25° for 52 and 53 series bearings and 32° for 32 and 33 series bearings. If we set $a_R$ equal to 0°, Equation (5) becomes:

$$\Delta_a = 2\sqrt{m_0^2 - \left(m_0 - \frac{\Delta_r}{2}\right)^2}$$

$$= 2\sqrt{m_0 \Delta_r - \frac{\Delta_r^2}{4}}$$

However, $\frac{\Delta_r^2}{4}$ is negligible.

$$\Delta_a \fallingdotseq 2 m_0^{1/2} \Delta_r^{1/2} \quad \cdots\cdots (6)$$

This is identical to the relationship between the radial and axial clearances in single-row deep groove ball bearings. The value of $m_0$ is dependent on the inner and outer ring groove radii. The relation between $\Delta_r$ and $\Delta_a$, as given by Equation (5), is shown in Figs. 2 and 3 for NSK 52, 53, 32, and 33 series double-row angular contact ball bearings. When the clearance range is small, the axial clearance is given approximately by

$$\Delta_a \fallingdotseq \Delta_r \cot a_R \quad \cdots\cdots (7)$$

However, when the clearance is relatively large, (when $\Delta_r/D_w > 0.002$) the error in Equation (7) can be quite large. The contact angle $a_R$ is independent of the radial clearance; however, the initial contact angle $a_0$ varies with the radial clearance when the inner or outer ring is displaced axially. This relationship is given by Equation (2).

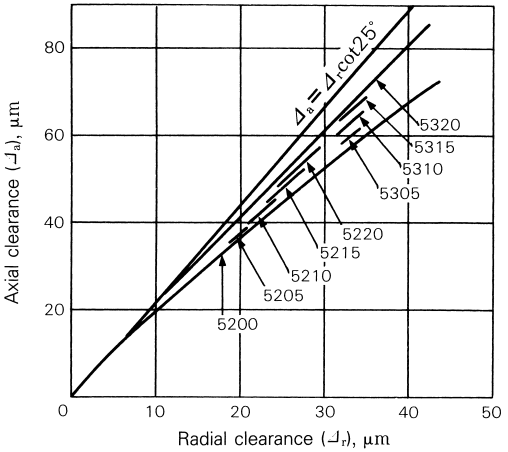



Fig. 2 Radial and Axial Clearances of Bearing Series 52 and 53

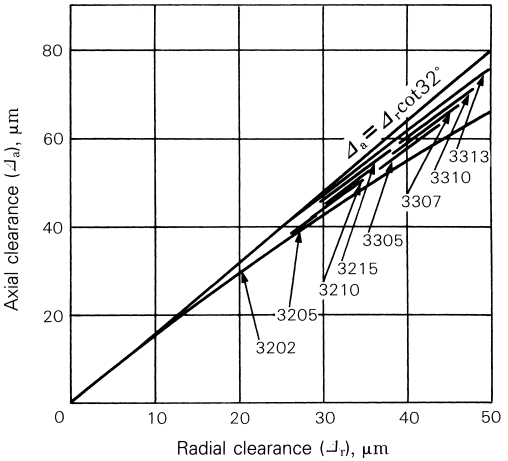
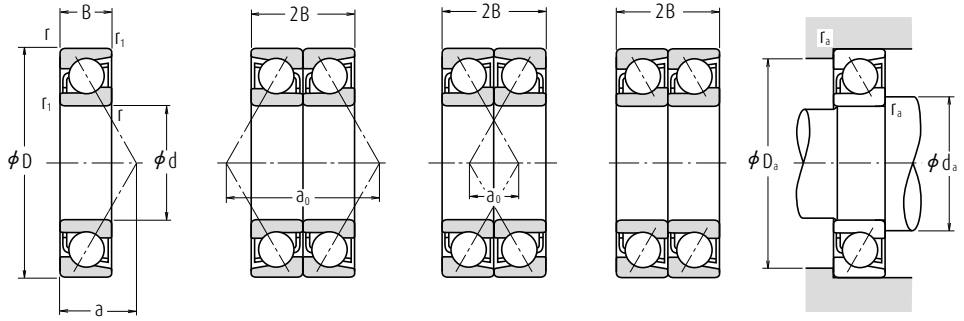



Fig. 3 Radial and Axial Clearances of Bearing Series 32 and 33

## Single/matched mountings
## Bore Diameter 10 – 15 mm




Single | Back-to-Back DB | Face-to-Face DF | Tandem DT

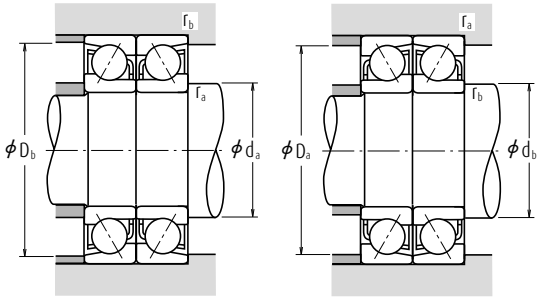
| Boundary Dimensions (mm) | | | | | Basic Load Ratings (Single) (N) | | Factor | Limiting Speeds (1) (min-1) | | Eff.Load Centers (mm) | Abutment and Fillet Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d | D | B | r min. | r1 min. | Cr | C0r | f0 | Grease | Oil | a | da min. | Da max. | ra max. | approx. |
| **10** | 22 | 6 | 0.3 | 0.15 | 3 000 | 1 450 | — | 62 500 | 93 800 | 6.7 | 12.5 | 19.5 | 0.3 | 0.009 |
| | 22 | 6 | 0.3 | 0.15 | 3 150 | 1 520 | 14.1 | 71 900 | 109 000 | 5.1 | 12.5 | 19.5 | 0.3 | 0.009 |
| | 26 | 8 | 0.3 | 0.15 | 5 250 | 2 340 | — | 41 700 | 55 600 | 9.2 | 12.5 | 23.5 | 0.3 | 0.019 |
| | 26 | 8 | 0.3 | 0.15 | 5 600 | 2 490 | 12.6 | 63 900 | 97 300 | 6.4 | 12.5 | 23.5 | 0.3 | 0.021 |
| | 30 | 9 | 0.6 | 0.3 | 5 300 | 2 440 | — | 37 500 | 50 000 | 10.3 | 15 | 25 | 0.6 | 0.032 |
| | 30 | 9 | 0.6 | 0.3 | 5 000 | 2 500 | — | 20 000 | 28 000 | 12.9 | 15 | 25 | 0.6 | 0.032 |
| | 30 | 9 | 0.6 | 0.3 | 5 650 | 2 610 | 13.2 | 57 500 | 87 500 | 7.2 | 15 | 25 | 0.6 | 0.036 |
| | 35 | 11 | 0.6 | 0.3 | 9 300 | 4 300 | — | 20 000 | 26 000 | 12.0 | 15 | 30 | 0.6 | 0.053 |
| | 35 | 11 | 0.6 | 0.3 | 8 750 | 4 050 | — | 18 000 | 24 000 | 14.9 | 15 | 30 | 0.6 | 0.054 |
| **12** | 24 | 6 | 0.3 | 0.15 | 3 350 | 1 770 | — | 55 600 | 83 400 | 7.2 | 14.5 | 21.5 | 0.3 | 0.011 |
| | 24 | 6 | 0.3 | 0.15 | 3 550 | 1 860 | 14.7 | 63 900 | 97 300 | 5.4 | 14.5 | 21.5 | 0.3 | 0.011 |
| | 28 | 8 | 0.3 | 0.15 | 5 700 | 2 710 | — | 37 500 | 50 000 | 9.8 | 14.5 | 25.5 | 0.3 | 0.021 |
| | 28 | 8 | 0.3 | 0.15 | 6 100 | 2 900 | 13.2 | 57 500 | 87 500 | 6.7 | 14.5 | 25.5 | 0.3 | 0.024 |
| | 32 | 10 | 0.6 | 0.3 | 7 850 | 3 650 | — | 34 100 | 45 500 | 11.4 | 17 | 27 | 0.6 | 0.037 |
| | 32 | 10 | 0.6 | 0.3 | 7 450 | 3 750 | — | 18 000 | 26 000 | 14.2 | 17 | 27 | 0.6 | 0.038 |
| | 32 | 10 | 0.6 | 0.3 | 8 150 | 3 750 | — | 20 000 | 30 000 | 14.2 | 17 | 27 | 0.6 | 0.036 |
| | 32 | 10 | 0.6 | 0.3 | 8 300 | 3 850 | 12.5 | 52 300 | 79 600 | 7.9 | 17 | 27 | 0.6 | 0.041 |
| | 37 | 12 | 1 | 0.6 | 9 450 | 4 500 | — | 18 000 | 24 000 | 13.1 | 18 | 31 | 1 | 0.060 |
| | 37 | 12 | 1 | 0.6 | 8 850 | 4 200 | — | 16 000 | 22 000 | 16.3 | 18 | 31 | 1 | 0.062 |
| | 37 | 12 | 1 | 0.6 | 11 100 | 4 950 | — | 18 000 | 26 000 | 16.3 | 18 | 31 | 1 | 0.061 |
| **15** | 28 | 7 | 0.3 | 0.15 | 4 750 | 2 530 | — | 46 600 | 69 800 | 8.5 | 17.5 | 25.5 | 0.3 | 0.015 |
| | 28 | 7 | 0.3 | 0.15 | 5 000 | 2 640 | 14.5 | 53 500 | 81 400 | 6.4 | 17.5 | 25.5 | 0.3 | 0.015 |
| | 32 | 9 | 0.3 | 0.15 | 6 050 | 3 150 | — | 32 000 | 42 600 | 11.3 | 17.5 | 29.5 | 0.3 | 0.030 |
| | 32 | 9 | 0.3 | 0.15 | 6 550 | 3 400 | 14.1 | 49 000 | 74 500 | 7.6 | 17.5 | 29.5 | 0.3 | 0.034 |
| | 35 | 11 | 0.6 | 0.3 | 8 500 | 4 250 | — | 30 000 | 40 000 | 12.7 | 20 | 30 | 0.6 | 0.045 |
| | 35 | 11 | 0.6 | 0.3 | 7 950 | 4 300 | — | 16 000 | 22 000 | 16.0 | 20 | 30 | 0.6 | 0.046 |
| | 35 | 11 | 0.6 | 0.3 | 9 800 | 4 800 | — | 18 000 | 26 000 | 16.0 | 20 | 30 | 0.6 | 0.044 |
| | 35 | 11 | 0.6 | 0.3 | 9 100 | 4 550 | 13.2 | 46 000 | 70 000 | 8.8 | 20 | 30 | 0.6 | 0.052 |
| | 42 | 13 | 1 | 0.6 | 13 400 | 7 100 | — | 16 000 | 22 000 | 14.7 | 21 | 36 | 1 | 0.084 |
| | 42 | 13 | 1 | 0.6 | 12 500 | 6 600 | — | 14 000 | 19 000 | 18.5 | 21 | 36 | 1 | 0.086 |
| | 42 | 13 | 1 | 0.6 | 14 300 | 6 900 | — | 16 000 | 22 000 | 18.5 | 21 | 36 | 1 | 0.084 |

**Notes**

(1) For applications operating near the limiting speed, refer to Page **B079**.

(2) The suffixes A, A5, B, and C represent contact angles of 30°, 25°, 40°, and 15° respectively.

(3) For bearings marked — in the column for $d_b$, $d_b$ and $r_b$ for shafts are $d_a$ (min.) and $r_a$ (max.) respectively.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| Contact Angle | $if_oF_a^*/C_{or}$ | e | Single, DT | | | | DB or DF | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $F_a/F_r \le e$ | | $F_a/F_r > e$ | | $F_a/F_r \le e$ | | $F_a/F_r > e$ | |
| | | | X | Y | X | Y | X | Y | X | Y |
| 15° | 0.178 | 0.38 | 1 | 0 | 0.44 | 1.47 | 1 | 1.65 | 0.72 | 2.39 |
| | 0.357 | 0.40 | 1 | 0 | 0.44 | 1.40 | 1 | 1.57 | 0.72 | 2.28 |
| | 0.714 | 0.43 | 1 | 0 | 0.44 | 1.30 | 1 | 1.46 | 0.72 | 2.11 |
| | 1.07 | 0.46 | 1 | 0 | 0.44 | 1.23 | 1 | 1.38 | 0.72 | 2.00 |
| | 1.43 | 0.47 | 1 | 0 | 0.44 | 1.19 | 1 | 1.34 | 0.72 | 1.93 |
| | 2.14 | 0.50 | 1 | 0 | 0.44 | 1.12 | 1 | 1.26 | 0.72 | 1.82 |
| | 3.57 | 0.55 | 1 | 0 | 0.44 | 1.02 | 1 | 1.14 | 0.72 | 1.66 |
| | 5.35 | 0.56 | 1 | 0 | 0.44 | 1.00 | 1 | 1.12 | 0.72 | 1.63 |
| 25° | — | 0.68 | 1 | 0 | 0.41 | 0.87 | 1 | 0.92 | 0.67 | 1.41 |
| 30° | — | 0.80 | 1 | 0 | 0.39 | 0.76 | 1 | 0.78 | 0.63 | 1.24 |
| 40° | — | 1.14 | 1 | 0 | 0.35 | 0.57 | 1 | 0.55 | 0.57 | 0.93 |

*For i, use 2 for DB, DF and 1 for DT

## Static Equivalent Load $P_o=X_oF_r+Y_oF_a$

| Contact Angle | Single, DT | | DB or DF | |
|---|---|---|---|---|
| | $X_o$ | $Y_o$ | $X_o$ | $Y_o$ |
| 15° | 0.5 | 0.46 | 1 | 0.92 |
| 25° | 0.5 | 0.38 | 1 | 0.76 |
| 30° | 0.5 | 0.33 | 1 | 0.66 |
| 40° | 0.5 | 0.26 | 1 | 0.52 |

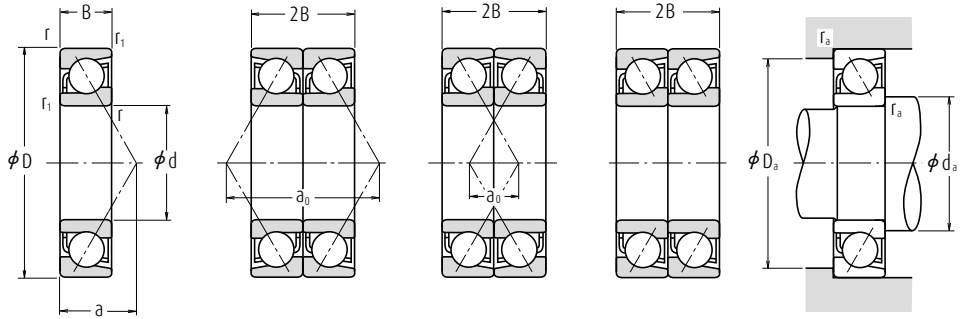
Single or DT mounting
When $F_r > 0.5F_r+Y_oF_a$ use $P_o=F_r$

| Bearing Numbers (2) Cage Symbol (4) | | | | | | Basic Load Ratings (Matched) (N) | | Limiting Speeds (1) (Matched) ($min^{-1}$) | | Load Center Spacings (mm) | | Abutment and Fillet Dimensions (mm) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | $a_0$ | | | | |
| Single | Standard | Option | Duplex | | | $C_r$ | $C_{0r}$ | Grease | Oil | DB | DF | $d_b$ (3) min. | $D_b$ max. | $r_b$ (3) max. |
| 7900 A5* | TYN | (M) | DB | DF | DT | 4 700 | 2 900 | 32 000 | 43 000 | 13.5 | 1.5 | — | 20.8 | 0.15 |
| 7900 C* | TYN | (M),T | DB | DF | DT | 4 900 | 3 050 | 38 000 | 53 000 | 10.3 | 1.7 | — | 20.8 | 0.15 |
| 7000 A* | W | (M), T,TYN | DB | DF | DT | 8 750 | 5 200 | 24 000 | 34 000 | 18.4 | 2.4 | 11.2 | 24.8 | 0.15 |
| 7000 C* | TYN | W,(M),T | DB | DF | DT | 8 650 | 5 000 | 36 000 | 50 000 | 12.8 | 3.2 | — | 24.8 | 0.15 |
| 7200 A* | W | (M), TYN | DB | DF | DT | 8 800 | 5 400 | 22 000 | 30 000 | 20.5 | 2.5 | 12.5 | 27.5 | 0.3 |
| 7200 B | W | (M), T | DB | DF | DT | 8 100 | 5 000 | 16 000 | 22 000 | 25.8 | 7.8 | 12.5 | 27.5 | 0.3 |
| 7200 C* | TYN | W,(M),T | DB | DF | DT | 8 800 | 5 200 | 32 000 | 45 000 | 14.4 | 3.6 | — | 27.5 | 0.3 |
| 7300 A | W | (M), T | DB | DF | DT | 15 100 | 8 600 | 16 000 | 22 000 | 24.0 | 2.0 | 12.5 | 32.5 | 0.3 |
| 7300 B | W | (M), T | DB | DF | DT | 14 200 | 8 100 | 14 000 | 20 000 | 29.9 | 7.9 | 12.5 | 32.5 | 0.3 |
| 7901 A5* | TYN | (M),T | DB | DF | DT | 5 200 | 3 550 | 30 000 | 43 000 | 14.4 | 2.4 | — | 22.8 | 0.15 |
| 7901 C* | TYN | (M),T | DB | DF | DT | 5 450 | 3 700 | 36 000 | 50 000 | 10.8 | 1.2 | — | 22.8 | 0.15 |
| 7001 A* | W | (M), T,TYN | DB | DF | DT | 9 400 | 5 950 | 22 000 | 30 000 | 19.5 | 3.5 | 13.2 | 26.8 | 0.15 |
| 7001 C* | TYN | W,(M),T | DB | DF | DT | 9 400 | 5 800 | 32 000 | 45 000 | 13.4 | 2.6 | — | 26.8 | 0.15 |
| 7201 A* | W | (M), T,TYN | DB | DF | DT | 13 000 | 8 050 | 20 000 | 28 000 | 22.7 | 2.7 | 14.5 | 29.5 | 0.3 |
| 7201 B | W | (M),T | DB | DF | DT | 12 100 | 7 500 | 15 000 | 20 000 | 28.5 | 8.5 | 14.5 | 29.5 | 0.3 |
| 7201 BEA* | T85 | — | — | — | — | — | — | 16 000 | 24 000 | 28.5 | 8.5 | 14.5 | 29.5 | 0.3 |
| 7201 C* | TYN | W,(M),T | DB | DF | DT | 12 800 | 7 700 | 30 000 | 40 000 | 15.9 | 4.1 | — | 29.5 | 0.3 |
| 7301 A | W | (M), T | DB | DF | DT | 15 400 | 9 000 | 15 000 | 20 000 | 26.1 | 2.1 | 17 | 32 | 0.6 |
| 7301 B | W | (M), T | DB | DF | DT | 14 400 | 8 400 | 13 000 | 18 000 | 32.6 | 8.6 | 17 | 32 | 0.6 |
| 7301 BEA* | T85 | — | — | — | — | — | — | 15 000 | 22 000 | 32.6 | 8.6 | 17 | 32 | 0.6 |
| 7902 A5* | TYN | (M),T | DB | DF | DT | 7 400 | 5 050 | 26 000 | 34 000 | 17.0 | 3.0 | — | 26.8 | 0.15 |
| 7902 C* | TYN | (M),T | DB | DF | DT | 7 750 | 5 300 | 30 000 | 43 000 | 12.8 | 1.2 | — | 26.8 | 0.15 |
| 7002 A* | W | (M), T,TYN | DB | DF | DT | 9 950 | 6 850 | 19 000 | 26 000 | 22.6 | 4.6 | 16.2 | 30.8 | 0.15 |
| 7002 C* | TYN | W, (M),T | DB | DF | DT | 10 100 | 6 750 | 28 000 | 38 000 | 15.3 | 2.7 | — | 30.8 | 0.15 |
| 7202 A* | W | (M), T,TYN | DB | DF | DT | 14 000 | 9 300 | 18 000 | 24 000 | 25.4 | 3.4 | 17.5 | 32.5 | 0.3 |
| 7202 B | W | (M),T | DB | DF | DT | 12 900 | 8 600 | 13 000 | 18 000 | 32.0 | 10.0 | 17.5 | 32.5 | 0.3 |
| 7202 BEA* | T85 | — | — | — | — | — | — | 14 000 | 20 000 | 32.0 | 10.0 | 17.5 | 32.5 | 0.3 |
| 7202 C* | TYN | W,(M),T | DB | DF | DT | 14 100 | 9 050 | 26 000 | 36 000 | 17.7 | 4.3 | — | 32.5 | 0.3 |
| 7302 A | W | (M), T | DB | DF | DT | 21 800 | 14 200 | 13 000 | 17 000 | 29.5 | 3.5 | 20 | 37 | 0.6 |
| 7302 B | W | (M), T | DB | DF | DT | 20 200 | 13 200 | 11 000 | 15 000 | 36.9 | 10.9 | 20 | 37 | 0.6 |
| 7302 BEA* | T85 | — | — | — | — | — | — | 13 000 | 18 000 | 36.9 | 10.9 | 20 | 37 | 0.6 |

**Note** (4) (M) in the column of cage symbols are usually omitted from the bearing number.

**Remark** The bearings denoted by an asterisk (*) are NSKHPS Angular contact ball bearings and the column of Duplex in Bearing Numbers indicates the universal matching.

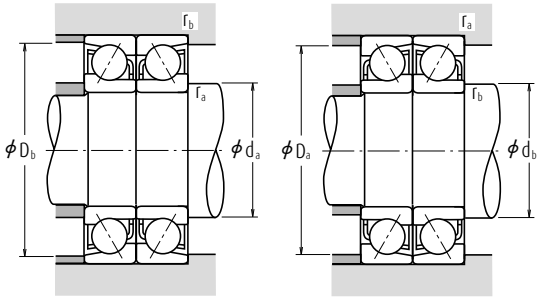
## Single/matched mountings
## Bore Diameter 17 – 25 mm




Single | Back-to-Back DB | Face-to-Face DF | Tandem DT

| Boundary Dimensions (mm) | | | | | Basic Load Ratings (Single) (N) | | Factor | Limiting Speeds (1) ($min^{-1}$) | | Eff.Load Centers (mm) | Abutment and Fillet Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d | D | B | r min. | $r_1$ min. | $C_r$ | $C_{0r}$ | $f_0$ | Grease | Oil | a | $d_a$ min. | $D_a$ max. | $r_a$ max. | approx. |
| **17** | 30 | 7 | 0.3 | 0.15 | 5 000 | 2 800 | — | 42 600 | 63 900 | 9.0 | 19.5 | 27.5 | 0.3 | 0.017 |
| | 30 | 7 | 0.3 | 0.15 | 5 250 | 2 940 | 14.8 | 49 000 | 74 500 | 6.6 | 19.5 | 27.5 | 0.3 | 0.017 |
| | 35 | 10 | 0.3 | 0.15 | 6 400 | 3 500 | — | 22 900 | 30 500 | 12.5 | 19.5 | 32.5 | 0.3 | 0.040 |
| | 35 | 10 | 0.3 | 0.15 | 6 950 | 3 800 | 14.5 | 44 300 | 67 400 | 8.5 | 19.5 | 32.5 | 0.3 | 0.044 |
| | 40 | 12 | 0.6 | 0.3 | 10 700 | 5 450 | — | 26 400 | 35 100 | 14.2 | 22 | 35 | 0.6 | 0.067 |
| | 40 | 12 | 0.6 | 0.3 | 9 950 | 5 500 | — | 14 000 | 19 000 | 18.0 | 22 | 35 | 0.6 | 0.068 |
| | 40 | 12 | 0.6 | 0.3 | 11 600 | 6 100 | — | 16 000 | 22 000 | 18.2 | 22 | 35 | 0.6 | 0.065 |
| | 40 | 12 | 0.6 | 0.3 | 11 400 | 5 850 | 13.3 | 40 400 | 61 500 | 9.8 | 22 | 35 | 0.6 | 0.075 |
| | 47 | 14 | 1 | 0.6 | 15 900 | 8 650 | — | 14 000 | 19 000 | 16.2 | 23 | 41 | 1 | 0.116 |
| | 47 | 14 | 1 | 0.6 | 14 800 | 8 000 | — | 13 000 | 17 000 | 20.4 | 23 | 41 | 1 | 0.118 |
| | 47 | 14 | 1 | 0.6 | 16 800 | 8 300 | — | 14 000 | 20 000 | 20.4 | 23 | 41 | 1 | 0.113 |
| **20** | 37 | 9 | 0.3 | 0.15 | 6 950 | 4 050 | — | 35 100 | 52 700 | 11.1 | 22.5 | 34.5 | 0.3 | 0.036 |
| | 37 | 9 | 0.3 | 0.15 | 7 300 | 4 250 | 14.9 | 40 400 | 61 500 | 8.3 | 22.5 | 34.5 | 0.3 | 0.036 |
| | 42 | 12 | 0.6 | 0.3 | 10 800 | 6 100 | — | 24 200 | 32 300 | 14.9 | 25 | 37 | 0.6 | 0.068 |
| | 42 | 12 | 0.6 | 0.3 | 11 700 | 6 550 | 14.0 | 37 100 | 56 500 | 10.1 | 25 | 37 | 0.6 | 0.076 |
| | 47 | 14 | 1 | 0.6 | 14 300 | 7 550 | — | 22 400 | 29 900 | 16.7 | 26 | 41 | 1 | 0.106 |
| | 47 | 14 | 1 | 0.6 | 13 300 | 7 650 | — | 12 000 | 16 000 | 21.1 | 26 | 41 | 1 | 0.109 |
| | 47 | 14 | 1 | 0.6 | 15 600 | 8 150 | — | 13 000 | 19 000 | 21.1 | 26 | 41 | 1 | 0.103 |
| | 47 | 14 | 1 | 0.6 | 15 300 | 8 050 | 13.3 | 34 400 | 52 300 | 11.5 | 26 | 41 | 1 | 0.118 |
| | 52 | 15 | 1.1 | 0.6 | 18 700 | 10 400 | — | 13 000 | 17 000 | 17.9 | 27 | 45 | 1 | 0.146 |
| | 52 | 15 | 1.1 | 0.6 | 17 300 | 9 650 | — | 11 000 | 15 000 | 22.6 | 27 | 45 | 1 | 0.15 |
| | 52 | 15 | 1.1 | 0.6 | 19 800 | 10 500 | — | 13 000 | 18 000 | 22.6 | 27 | 45 | 1 | 0.149 |
| **25** | 42 | 9 | 0.3 | 0.15 | 7 800 | 5 150 | — | 29 900 | 44 800 | 12.3 | 27.5 | 39.5 | 0.3 | 0.043 |
| | 42 | 9 | 0.3 | 0.15 | 8 250 | 5 400 | 15.5 | 34 400 | 52 300 | 9.0 | 27.5 | 39.5 | 0.3 | 0.042 |
| | 47 | 12 | 0.6 | 0.3 | 11 300 | 6 850 | — | 22 900 | 27 800 | 16.4 | 30 | 42 | 0.6 | 0.079 |
| | 47 | 12 | 0.6 | 0.3 | 12 300 | 7 400 | 14.7 | 32 000 | 48 700 | 10.8 | 30 | 42 | 0.6 | 0.089 |
| | 52 | 15 | 1 | 0.6 | 16 100 | 9 450 | — | 19 500 | 26 000 | 18.6 | 31 | 46 | 1 | 0.13 |
| | 52 | 15 | 1 | 0.6 | 14 800 | 9 400 | — | 10 000 | 14 000 | 23.7 | 31 | 46 | 1 | 0.133 |
| | 52 | 15 | 1 | 0.6 | 17 600 | 10 200 | — | 12 000 | 17 000 | 23.7 | 31 | 46 | 1 | 0.127 |
| | 52 | 15 | 1 | 0.6 | 17 400 | 10 200 | 14.0 | 29 900 | 45 500 | 12.7 | 31 | 46 | 1 | 0.143 |
| | 62 | 17 | 1.1 | 0.6 | 26 400 | 15 800 | — | 10 000 | 14 000 | 21.1 | 32 | 55 | 1 | 0.235 |

**Notes**
(1) For applications operating near the limiting speed, refer to Page **B079**.
(2) The suffixes A, A5, B, and C represent contact angles of 30°, 25°, 40°, and 15° respectively.
(3) For bearings marked — in the column for $d_b$, $d_b$ and $r_b$ for shafts are $d_a$ (min.) and $r_a$ (max.) respectively.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| Contact Angle | $if_oF_a^*/C_{or}$ | e | Single, DT | | | | DB or DF | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $F_a/F_r \le e$ | | $F_a/F_r > e$ | | $F_a/F_r \le e$ | | $F_a/F_r > e$ | |
| | | | X | Y | X | Y | X | Y | X | Y |
| 15° | 0.178 | 0.38 | 1 | 0 | 0.44 | 1.47 | 1 | 1.65 | 0.72 | 2.39 |
| | 0.357 | 0.40 | 1 | 0 | 0.44 | 1.40 | 1 | 1.57 | 0.72 | 2.28 |
| | 0.714 | 0.43 | 1 | 0 | 0.44 | 1.30 | 1 | 1.46 | 0.72 | 2.11 |
| | 1.07 | 0.46 | 1 | 0 | 0.44 | 1.23 | 1 | 1.38 | 0.72 | 2.00 |
| | 1.43 | 0.47 | 1 | 0 | 0.44 | 1.19 | 1 | 1.34 | 0.72 | 1.93 |
| | 2.14 | 0.50 | 1 | 0 | 0.44 | 1.12 | 1 | 1.26 | 0.72 | 1.82 |
| | 3.57 | 0.55 | 1 | 0 | 0.44 | 1.02 | 1 | 1.14 | 0.72 | 1.66 |
| | 5.35 | 0.56 | 1 | 0 | 0.44 | 1.00 | 1 | 1.12 | 0.72 | 1.63 |
| 25° | — | 0.68 | 1 | 0 | 0.41 | 0.87 | 1 | 0.92 | 0.67 | 1.41 |
| 30° | — | 0.80 | 1 | 0 | 0.39 | 0.76 | 1 | 0.78 | 0.63 | 1.24 |
| 40° | — | 1.14 | 1 | 0 | 0.35 | 0.57 | 1 | 0.55 | 0.57 | 0.93 |

*For i, use 2 for DB, DF and 1 for DT

## Static Equivalent Load $P_o=X_oF_r+Y_oF_a$

| Contact Angle | Single, DT | | DB or DF | |
|---|---|---|---|---|
| | $X_o$ | $Y_o$ | $X_o$ | $Y_o$ |
| 15° | 0.5 | 0.46 | 1 | 0.92 |
| 25° | 0.5 | 0.38 | 1 | 0.76 |
| 30° | 0.5 | 0.33 | 1 | 0.66 |
| 40° | 0.5 | 0.26 | 1 | 0.52 |

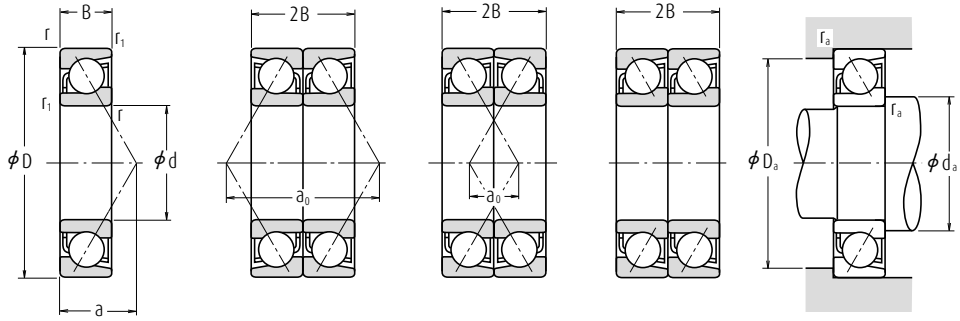
Single or DT mounting
When $F_r > 0.5F_r+Y_oF_a$
use $P_o=F_r$

| Bearing Numbers (2) Cage Symbol (4) | | | | | | Basic Load Ratings (Matched) (N) | | Limiting Speeds (1) (Matched) ($min^{-1}$) | | Load Center Spacings (mm) | | Abutment and Fillet Dimensions (mm) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | $a_0$ | | | | |
| Single | Standard | Option | Duplex | | | $C_r$ | $C_{0r}$ | Grease | Oil | DB | DF | $d_b$ (3) min. | $D_b$ max. | $r_b$ (3) max. |
| 7903 A5* | TYN | (M),T | DB | DF | DT | 7 750 | 5 600 | 24 000 | 32 000 | 18.0 | 4.0 | — | 28.8 | 0.15 |
| 7903 C* | TYN | (M),T | DB | DF | DT | 8 150 | 5 850 | 28 000 | 38 000 | 13.3 | 0.7 | — | 28.8 | 0.15 |
| 7003 A* | W | (M), T,TYN | DB | DF | DT | 10 400 | 7 650 | 17 000 | 24 000 | 25.0 | 5.0 | 18.2 | 33.8 | 0.15 |
| 7003 C* | TYN | W, (M),T | DB | DF | DT | 10 700 | 7 600 | 26 000 | 34 000 | 17.0 | 3.0 | — | 33.8 | 0.15 |
| 7203 A* | W | (M), T,TYN | DB | DF | DT | 17 600 | 12 000 | 16 000 | 22 000 | 28.5 | 4.5 | 19.5 | 37.5 | 0.3 |
| 7203 B | W | (M),T | DB | DF | DT | 16 100 | 11 000 | 11 000 | 15 000 | 35.9 | 11.9 | 19.5 | 37.5 | 0.3 |
| 7203 BEA* | T85 | T7 | — | — | — | — | — | 13 000 | 18 000 | 36.3 | 12.3 | 19.5 | 37.5 | 0.3 |
| 7203 C* | TYN | W,(M),T | DB | DF | DT | 17 600 | 11 700 | 22 000 | 32 000 | 19.6 | 4.4 | — | 37.5 | 0.3 |
| 7303 A | W | (M), T | DB | DF | DT | 25 900 | 17 300 | 11 000 | 15 000 | 32.5 | 4.5 | 22 | 42 | 0.6 |
| 7303 B | W | (M), T | DB | DF | DT | 24 000 | 16 000 | 10 000 | 14 000 | 40.9 | 12.9 | 22 | 42 | 0.6 |
| 7303 BEA* | T85 | — | — | — | — | — | — | 11 000 | 16 000 | 40.9 | 12.9 | 22 | 42 | 0.6 |
| 7904 A5* | TYN | (M),T | DB | DF | DT | 10 700 | 8 100 | 19 000 | 26 000 | 22.3 | 4.3 | — | 35.8 | 0.15 |
| 7904 C* | TYN | (M),T | DB | DF | DT | 11 300 | 8 500 | 22 000 | 32 000 | 16.6 | 1.4 | — | 35.8 | 0.15 |
| 7004 A* | W | (M), T,TYN | DB | DF | DT | 17 600 | 13 200 | 15 000 | 20 000 | 29.9 | 5.9 | 22.5 | 39.5 | 0.3 |
| 7004 C* | TYN | W,(M),T | DB | DF | DT | 18 000 | 13 100 | 20 000 | 30 000 | 20.3 | 3.7 | — | 39.5 | 0.3 |
| 7204 A* | W | (M), T,TYN | DB | DF | DT | 23 500 | 16 600 | 13 000 | 19 000 | 33.3 | 5.3 | 25 | 42 | 0.6 |
| 7204 B | W | (M),T | DB | DF | DT | 21 600 | 15 300 | 9 500 | 13 000 | 42.1 | 14.1 | 25 | 42 | 0.6 |
| 7204 BEA* | T85 | T7 | — | — | — | — | — | 11 000 | 16 000 | 42.1 | 14.1 | 25 | 42 | 0.6 |
| 7204 C* | TYN | W,(M),T | DB | DF | DT | 23 600 | 16 100 | 19 000 | 26 000 | 23.0 | 5.0 | — | 42 | 0.6 |
| 7304 A | W | (M), T | DB | DF | DT | 30 500 | 20 800 | 10 000 | 13 000 | 35.8 | 5.8 | 25 | 47 | 0.6 |
| 7304 B | W | (M), T | DB | DF | DT | 28 200 | 19 300 | 9 000 | 12 000 | 45.2 | 15.2 | 25 | 47 | 0.6 |
| 7304 BEA* | T85 | MR, T7 | — | — | — | — | — | 10 000 | 14 000 | 45.2 | 15.2 | 25 | 47 | 0.6 |
| 7905 A5* | TYN | (M),T | DB | DF | DT | 12 100 | 10 300 | 16 000 | 22 000 | 24.6 | 6.6 | — | 40.8 | 0.15 |
| 7905 C* | TYN | (M),T | DB | DF | DT | 12 700 | 10 800 | 19 000 | 26 000 | 18.0 | 0.0 | — | 40.8 | 0.15 |
| 7005 A* | W | (M), T,TYN | DB | DF | DT | 18 300 | 14 800 | 13 000 | 17 000 | 32.8 | 8.8 | 27.5 | 44.5 | 0.3 |
| 7005 C* | TYN | W,(M),T | DB | DF | DT | 19 000 | 14 800 | 18 000 | 26 000 | 21.6 | 2.4 | — | 44.5 | 0.3 |
| 7205 A* | W | (M), T,TYN | DB | DF | DT | 26 300 | 20 500 | 12 000 | 16 000 | 37.2 | 7.2 | 30 | 47 | 0.6 |
| 7205 B | W | (M),T | DB | DF | DT | 24 000 | 18 800 | 8 500 | 11 000 | 47.3 | 17.3 | 30 | 47 | 0.6 |
| 7205 BEA* | T85 | T7 | — | — | — | — | — | 9 500 | 14 000 | 47.3 | 17.3 | 30 | 47 | 0.6 |
| 7205 C* | TYN | W,(M),T | DB | DF | DT | 27 000 | 20 400 | 17 000 | 24 000 | 25.3 | 4.7 | — | 47 | 0.6 |
| 7305 A | W | (M), T | DB | DF | DT | 43 000 | 31 500 | 8 500 | 11 000 | 42.1 | 8.1 | 30 | 57 | 0.6 |

**Note** (4) (M) in the column of cage symbols are usually omitted from the bearing number.

**Remark** The bearings denoted by an asterisk (*) are NSKHPS Angular contact ball bearings and the column of Duplex in Bearing Numbers indicates the universal matching.

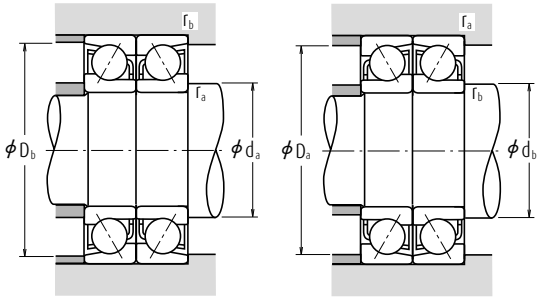
## Single/matched mountings
## Bore Diameter 25 – 40 mm




Single | Back-to-Back DB | Face-to-Face DF | Tandem DT

| Boundary Dimensions (mm) | | | | | Basic Load Ratings (Single) (N) | | Factor | Limiting Speeds (1) ($min^{-1}$) | | Eff.Load Centers (mm) | Abutment and Fillet Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d | D | B | r min. | $r_1$ min. | $C_r$ | $C_{0r}$ | $f_0$ | Grease | Oil | a | $d_a$ min. | $D_a$ max. | $r_a$ max. | approx. |
| **25** | 62 | 17 | 1.1 | 0.6 | 24 400 | 14 600 | — | 9 000 | 13 000 | 26.7 | 32 | 55 | 1 | 0.241 |
| | 62 | 17 | 1.1 | 0.6 | 27 200 | 14 900 | — | 10 000 | 15 000 | 26.8 | 32 | 55 | 1 | 0.229 |
| **30** | 47 | 9 | 0.3 | 0.15 | 8 250 | 5 950 | — | 26 000 | 39 000 | 13.5 | 32.5 | 44.5 | 0.3 | 0.049 |
| | 47 | 9 | 0.3 | 0.15 | 8 700 | 6 250 | 15.9 | 29 900 | 45 500 | 9.7 | 32.5 | 44.5 | 0.3 | 0.049 |
| | 55 | 13 | 1 | 0.6 | 14 600 | 9 450 | — | 17 700 | 23 600 | 18.8 | 36 | 49 | 1 | 0.116 |
| | 55 | 13 | 1 | 0.6 | 15 900 | 10 300 | 14.9 | 27 100 | 41 200 | 12.2 | 36 | 49 | 1 | 0.134 |
| | 62 | 16 | 1 | 0.6 | 22 400 | 13 600 | — | 16 400 | 21 800 | 21.3 | 36 | 56 | 1 | 0.197 |
| | 62 | 16 | 1 | 0.6 | 20 500 | 13 500 | — | 8 500 | 12 000 | 27.3 | 36 | 56 | 1 | 0.202 |
| | 62 | 16 | 1 | 0.6 | 23 700 | 14 300 | — | 10 000 | 14 000 | 27.3 | 36 | 56 | 1 | 0.194 |
| | 62 | 16 | 1 | 0.6 | 24 200 | 14 700 | 13.9 | 25 000 | 38 100 | 14.2 | 36 | 56 | 1 | 0.222 |
| | 72 | 19 | 1.1 | 0.6 | 33 500 | 20 900 | — | 9 000 | 12 000 | 24.2 | 37 | 65 | 1 | 0.346 |
| | 72 | 19 | 1.1 | 0.6 | 31 000 | 19 300 | — | 8 000 | 11 000 | 30.9 | 37 | 65 | 1 | 0.354 |
| | 72 | 19 | 1.1 | 0.6 | 36 500 | 20 600 | — | 9 000 | 13 000 | 30.9 | 37 | 65 | 1 | 0.336 |
| **35** | 55 | 10 | 0.6 | 0.3 | 12 000 | 8 700 | — | 22 300 | 33 400 | 15.5 | 40 | 50 | 0.6 | 0.074 |
| | 55 | 10 | 0.6 | 0.3 | 12 700 | 9 150 | 15.7 | 25 600 | 38 900 | 11.0 | 40 | 50 | 0.6 | 0.074 |
| | 62 | 14 | 1 | 0.6 | 18 400 | 12 600 | — | 15 500 | 20 700 | 21.0 | 41 | 56 | 1 | 0.153 |
| | 62 | 14 | 1 | 0.6 | 20 100 | 13 700 | 15.0 | 23 800 | 36 100 | 13.5 | 41 | 56 | 1 | 0.173 |
| | 72 | 17 | 1.1 | 0.6 | 29 600 | 18 500 | — | 14 100 | 18 700 | 23.9 | 42 | 65 | 1 | 0.287 |
| | 72 | 17 | 1.1 | 0.6 | 27 100 | 18 400 | — | 7 500 | 10 000 | 30.9 | 42 | 65 | 1 | 0.294 |
| | 72 | 17 | 1.1 | 0.6 | 32 500 | 19 600 | — | 8 500 | 12 000 | 30.9 | 42 | 65 | 1 | 0.271 |
| | 72 | 17 | 1.1 | 0.6 | 32 000 | 19 900 | 13.9 | 21 500 | 32 800 | 15.7 | 42 | 65 | 1 | 0.32 |
| | 80 | 21 | 1.5 | 1 | 40 000 | 26 300 | — | 8 000 | 10 000 | 27.1 | 44 | 71 | 1.5 | 0.469 |
| | 80 | 21 | 1.5 | 1 | 40 500 | 24 400 | — | 5 600 | 7 500 | 34.6 | 44 | 71 | 1.5 | 0.474 |
| | 80 | 21 | 1.5 | 1 | 40 500 | 24 400 | — | 8 000 | 11 000 | 34.6 | 44 | 71 | 1.5 | 0.451 |
| **40** | 62 | 12 | 0.6 | 0.3 | 14 300 | 11 200 | — | 14 000 | 18 000 | 17.9 | 45 | 57 | 0.6 | 0.11 |
| | 62 | 12 | 0.6 | 0.3 | 15 900 | 11 700 | 15.7 | 22 600 | 34 400 | 12.8 | 45 | 57 | 0.6 | 0.109 |
| | 68 | 15 | 1 | 0.6 | 19 700 | 14 600 | — | 13 900 | 18 600 | 23.1 | 46 | 62 | 1 | 0.19 |
| | 68 | 15 | 1 | 0.6 | 21 600 | 15 900 | 15.4 | 21 300 | 32 500 | 14.7 | 46 | 62 | 1 | 0.213 |
| | 80 | 18 | 1.1 | 0.6 | 35 500 | 23 300 | — | 12 500 | 16 700 | 26.3 | 47 | 73 | 1 | 0.375 |
| | 80 | 18 | 1.1 | 0.6 | 32 000 | 23 000 | — | 6 700 | 9 000 | 34.2 | 47 | 73 | 1 | 0.383 |

**Notes**
(1) For applications operating near the limiting speed, refer to Page **B079**.
(2) The suffixes A, A5, B, and C represent contact angles of 30°, 25°, 40°, and 15° respectively.
(3) For bearings marked — in the column for $d_b$, $d_b$ and $r_b$ for shafts are $d_a$ (min.) and $r_a$ (max.) respectively.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| Contact Angle | $if_oF_a^*/C_{or}$ | e | Single, DT | | | | DB or DF | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $F_a/F_r \le e$ | | $F_a/F_r > e$ | | $F_a/F_r \le e$ | | $F_a/F_r > e$ | |
| | | | X | Y | X | Y | X | Y | X | Y |
| 15° | 0.178 | 0.38 | 1 | 0 | 0.44 | 1.47 | 1 | 1.65 | 0.72 | 2.39 |
| | 0.357 | 0.40 | 1 | 0 | 0.44 | 1.40 | 1 | 1.57 | 0.72 | 2.28 |
| | 0.714 | 0.43 | 1 | 0 | 0.44 | 1.30 | 1 | 1.46 | 0.72 | 2.11 |
| | 1.07 | 0.46 | 1 | 0 | 0.44 | 1.23 | 1 | 1.38 | 0.72 | 2.00 |
| | 1.43 | 0.47 | 1 | 0 | 0.44 | 1.19 | 1 | 1.34 | 0.72 | 1.93 |
| | 2.14 | 0.50 | 1 | 0 | 0.44 | 1.12 | 1 | 1.26 | 0.72 | 1.82 |
| | 3.57 | 0.55 | 1 | 0 | 0.44 | 1.02 | 1 | 1.14 | 0.72 | 1.66 |
| | 5.35 | 0.56 | 1 | 0 | 0.44 | 1.00 | 1 | 1.12 | 0.72 | 1.63 |
| 25° | — | 0.68 | 1 | 0 | 0.41 | 0.87 | 1 | 0.92 | 0.67 | 1.41 |
| 30° | — | 0.80 | 1 | 0 | 0.39 | 0.76 | 1 | 0.78 | 0.63 | 1.24 |
| 40° | — | 1.14 | 1 | 0 | 0.35 | 0.57 | 1 | 0.55 | 0.57 | 0.93 |

*For i, use 2 for DB, DF and 1 for DT

## Static Equivalent Load $P_o=X_oF_r+Y_oF_a$

| Contact Angle | Single, DT | | DB or DF | |
|---|---|---|---|---|
| | $X_o$ | $Y_o$ | $X_o$ | $Y_o$ |
| 15° | 0.5 | 0.46 | 1 | 0.92 |
| 25° | 0.5 | 0.38 | 1 | 0.76 |
| 30° | 0.5 | 0.33 | 1 | 0.66 |
| 40° | 0.5 | 0.26 | 1 | 0.52 |

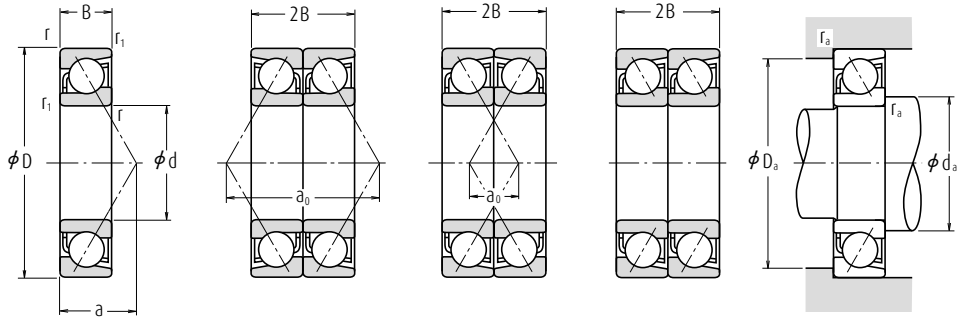
Single or DT mounting
When $F_r > 0.5F_r+Y_oF_a$
use $P_o=F_r$

| Bearing Numbers (2) Cage Symbol (4) | | | | | | Basic Load Ratings (Matched) (N) | | Limiting Speeds (1) (Matched) ($min^{-1}$) | | Load Center Spacings (mm) | | Abutment and Fillet Dimensions (mm) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | $a_0$ | | | | |
| Single | Standard | Option | Duplex | | | $C_r$ | $C_{0r}$ | Grease | Oil | DB | DF | $d_b$ (3) min. | $D_b$ max. | $r_b$ (3) max. |
| 7305 B | W | (M), T | DB | DF | DT | 39 500 | 29 300 | 7 500 | 10 000 | 53.5 | 19.5 | 30 | 57 | 0.6 |
| 7305 BEA* | T85 | MR, T7 | — | — | — | — | — | 8 500 | 12 000 | 53.5 | 19.5 | 30 | 57 | 0.6 |
| 7906 A5* | TYN | (M),T | DB | DF | DT | 12 800 | 11 900 | 14 000 | 19 000 | 27.0 | 9.0 | — | 45.8 | 0.15 |
| 7906 C* | TYN | (M),T | DB | DF | DT | 13 500 | 12 500 | 17 000 | 24 000 | 19.3 | 1.3 | — | 45.8 | 0.15 |
| 7006 A* | W | (M), T,TYN | DB | DF | DT | 23 600 | 20 200 | 11 000 | 15 000 | 37.5 | 11.5 | 35 | 50 | 0.6 |
| 7006 C* | TYN | W,(M),T | DB | DF | DT | 24 600 | 20 500 | 15 000 | 22 000 | 24.4 | 1.6 | — | 50 | 0.6 |
| 7206 A* | W | (M), T,TYN | DB | DF | DT | 36 500 | 29 500 | 10 000 | 13 000 | 42.6 | 10.6 | 35 | 57 | 0.6 |
| 7206 B | W | (M),T | DB | DF | DT | 33 500 | 27 000 | 7 100 | 9 500 | 54.6 | 22.6 | 35 | 57 | 0.6 |
| 7206 BEA* | T85 | MR, T7 | — | — | — | — | — | 8 000 | 11 000 | 54.6 | 22.6 | 35 | 57 | 0.6 |
| 7206 C* | TYN | W,(M),T | DB | DF | DT | 37 500 | 29 300 | 14 000 | 20 000 | 28.3 | 3.7 | — | 57 | 0.6 |
| 7306 A | W | (M), T | DB | DF | DT | 54 500 | 41 500 | 7 100 | 9 500 | 48.4 | 10.4 | 35 | 67 | 0.6 |
| 7306 B | W | (M), T | DB | DF | DT | 50 500 | 38 500 | 6 300 | 8 500 | 61.8 | 23.8 | 35 | 67 | 0.6 |
| 7306 BEA* | T85 | MR, T7 | — | — | — | — | — | 7 100 | 10 000 | 61.8 | 23.8 | 35 | 67 | 0.6 |
| 7907 A5* | TYN | (M),T | DB | DF | DT | 18 600 | 17 400 | 12 000 | 17 000 | 31.0 | 11.0 | — | 52.5 | 0.3 |
| 7907 C* | TYN | (M),T | DB | DF | DT | 19 600 | 18 300 | 14 000 | 20 000 | 22.1 | 2.1 | — | 52.5 | 0.3 |
| 7007 A* | W | (M), T,TYN | DB | DF | DT | 29 700 | 26 800 | 9 500 | 13 000 | 42.0 | 14.0 | 40 | 57 | 0.6 |
| 7007 C* | TYN | W,(M),T | DB | DF | DT | 31 000 | 27 300 | 13 000 | 19 000 | 27.0 | 1.0 | — | 57 | 0.6 |
| 7207 A* | W | (M), T,TYN | DB | DF | DT | 48 500 | 40 000 | 8 500 | 12 000 | 47.9 | 13.9 | 40 | 67 | 0.6 |
| 7207 BEA | W | MR, T7 | DB | DF | DT | 65 500 | 49 000 | 4 500 | 6000 | 69.2 | 27.2 | 41 | 74 | 1 |
| 7207 BEA* | T85 | MR, T7 | — | — | — | — | — | 6 700 | 9 500 | 61.9 | 27.9 | 40 | 67 | 0.6 |
| 7207 C* | (M) | W,T,TYN | DB | DF | DT | 49 500 | 40 000 | 12 000 | 17 000 | 31.3 | 2.7 | — | 67 | 0.6 |
| 7307 A | W | (M), T | DB | DF | DT | 65 000 | 52 500 | 6 300 | 8 500 | 54.2 | 12.2 | 41 | 74 | 1 |
| 7307 B | W | (M), T | DB | DF | DT | 59 500 | 48 500 | 5 600 | 7 500 | 69.2 | 27.2 | 41 | 74 | 1 |
| 7307 BEA* | T85 | MR, T7 | — | — | — | — | — | 6 300 | 9 000 | 69.2 | 27.2 | 41 | 74 | 1 |
| 7908 A5 | TYN | (M),T | DB | DF | DT | 23 300 | 22 300 | 11 000 | 15 000 | 35.8 | 11.8 | — | 59.5 | 0.3 |
| 7908 C* | TYN | (M),T | DB | DF | DT | 24 600 | 23 500 | 13 000 | 18 000 | 25.7 | 1.7 | — | 59.5 | 0.3 |
| 7008 A* | W | (M), T,TYN | DB | DF | DT | 31 500 | 31 000 | 8 500 | 11 000 | 46.2 | 16.2 | 45 | 63 | 0.6 |
| 7008 C* | (M) | W,T, TYN | DB | DF | DT | 33 500 | 32 000 | 12 000 | 17 000 | 29.5 | 0.5 | — | 63 | 0.6 |
| 7208 A* | W | (M), T,TYN | DB | DF | DT | 57 500 | 50 500 | 7 500 | 10 000 | 52.6 | 16.6 | 45 | 75 | 0.6 |
| 7208 B | W | (M),T | DB | DF | DT | 52 000 | 46 000 | 5 300 | 7 500 | 68.3 | 32.3 | 45 | 75 | 0.6 |

**Note** (4) (M) in the column of cage symbols are usually omitted from the bearing number.

**Remark** The bearings denoted by an asterisk (*) are NSKHPS Angular contact ball bearings and the column of Duplex in Bearing Numbers indicates the universal matching.

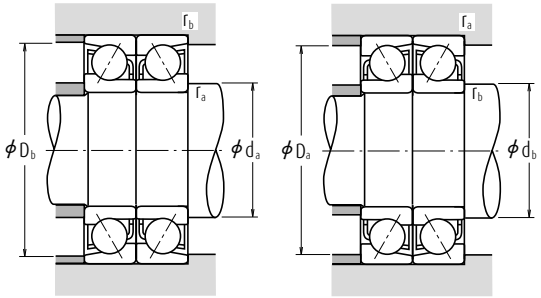
## Single/matched mountings
## Bore Diameter 40 – 55 mm




Single | Back-to-Back DB | Face-to-Face DF | Tandem DT

| Boundary Dimensions (mm) | | | | | Basic Load Ratings (Single) (N) | | Factor | Limiting Speeds (1) ($min^{-1}$) | | Eff.Load Centers (mm) | Abutment and Fillet Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d | D | B | r min. | $r_1$ min. | $C_r$ | $C_{0r}$ | $f_0$ | Grease | Oil | a | $d_a$ min. | $D_a$ max. | $r_a$ max. | approx. |
| **40** | 80 | 18 | 1.1 | 0.6 | 38 500 | 24 500 | — | 7 500 | 11 000 | 34.2 | 47 | 73 | 1 | 0.357 |
| | 80 | 18 | 1.1 | 0.6 | 38 000 | 25 200 | 14.1 | 19 200 | 29 200 | 17.0 | 47 | 73 | 1 | 0.418 |
| | 90 | 23 | 1.5 | 1 | 49 000 | 33 000 | — | 7 100 | 9 000 | 30.3 | 49 | 81 | 1.5 | 0.633 |
| | 90 | 23 | 1.5 | 1 | 53 000 | 33 000 | — | 5 000 | 6 700 | 38.8 | 49 | 81 | 1.5 | 0.644 |
| | 90 | 23 | 1.5 | 1 | 53 000 | 33 000 | — | 7 100 | 10 000 | 38.8 | 49 | 81 | 1.5 | 0.619 |
| **45** | 68 | 12 | 0.6 | 0.3 | 15 900 | 12 700 | — | 17 700 | 26 600 | 19.2 | 50 | 63 | 0.6 | 0.13 |
| | 68 | 12 | 0.6 | 0.3 | 16 800 | 13 400 | 16.0 | 20 400 | 31 000 | 13.6 | 50 | 63 | 0.6 | 0.129 |
| | 75 | 16 | 1 | 0.6 | 23 400 | 17 700 | — | 12 500 | 16 700 | 25.3 | 51 | 69 | 1 | 0.25 |
| | 75 | 16 | 1 | 0.6 | 25 600 | 19 300 | 15.4 | 19 200 | 29 200 | 16.0 | 51 | 69 | 1 | 0.274 |
| | 85 | 19 | 1.1 | 0.6 | 39 500 | 26 700 | — | 11 600 | 15 400 | 28.3 | 52 | 78 | 1 | 0.411 |
| | 85 | 19 | 1.1 | 0.6 | 36 000 | 26 200 | — | 6 300 | 8 500 | 36.8 | 52 | 78 | 1 | 0.421 |
| | 85 | 19 | 1.1 | 0.6 | 40 500 | 27 100 | — | 7 100 | 10 000 | 36.8 | 52 | 78 | 1 | 0.40 |
| | 85 | 19 | 1.1 | 0.6 | 43 000 | 28 800 | 14.2 | 17 700 | 27 000 | 18.2 | 52 | 78 | 1 | 0.468 |
| | 100 | 25 | 1.5 | 1 | 63 500 | 43 500 | — | 6 300 | 8 500 | 33.4 | 54 | 91 | 1.5 | 0.848 |
| | 100 | 25 | 1.5 | 1 | 62 500 | 39 500 | — | 4 500 | 6 000 | 42.9 | 54 | 91 | 1.5 | 0.860 |
| | 100 | 25 | 1.5 | 1 | 62 500 | 39 500 | — | 6 300 | 9 000 | 42.9 | 54 | 91 | 1.5 | 0.823 |
| **50** | 72 | 12 | 0.6 | 0.3 | 16 700 | 14 200 | — | 16 400 | 24 600 | 20.2 | 55 | 67 | 0.6 | 0.132 |
| | 72 | 12 | 0.6 | 0.3 | 17 700 | 15 000 | 16.2 | 18 900 | 28 700 | 14.2 | 55 | 67 | 0.6 | 0.13 |
| | 80 | 16 | 1 | 0.6 | 24 900 | 21 100 | — | 11 600 | 15 400 | 26.8 | 56 | 74 | 1 | 0.263 |
| | 80 | 16 | 1 | 0.6 | 27 300 | 21 900 | 15.7 | 17 700 | 27 000 | 16.7 | 56 | 74 | 1 | 0.293 |
| | 90 | 20 | 1.1 | 0.6 | 41 500 | 29 300 | — | 10 800 | 14 300 | 30.2 | 57 | 83 | 1 | 0.466 |
| | 90 | 20 | 1.1 | 0.6 | 37 500 | 28 600 | — | 5 600 | 8 000 | 39.4 | 57 | 83 | 1 | 0.477 |
| | 90 | 20 | 1.1 | 0.6 | 42 000 | 29 700 | — | 6 300 | 9 500 | 39.4 | 57 | 83 | 1 | 0.453 |
| | 90 | 20 | 1.1 | 0.6 | 45 000 | 31 500 | 14.5 | 16 500 | 25 000 | 19.4 | 57 | 83 | 1 | 0.528 |
| | 110 | 27 | 2 | 1 | 74 000 | 52 000 | — | 5 600 | 7 500 | 36.6 | 60 | 100 | 2 | 1.1 |
| | 110 | 27 | 2 | 1 | 78 000 | 50 500 | — | 4 000 | 5 600 | 47.1 | 60 | 100 | 2 | 1.11 |
| | 110 | 27 | 2 | 1 | 78 000 | 50 500 | — | 5 600 | 8 000 | 47.1 | 60 | 100 | 2 | 1.07 |
| **55** | 80 | 13 | 1 | 0.6 | 19 000 | 16 800 | — | 14 900 | 22 300 | 22.2 | 61 | 74 | 1 | 0.184 |
| | 80 | 13 | 1 | 0.6 | 20 100 | 17 700 | 16.3 | 17 100 | 26 000 | 15.5 | 61 | 74 | 1 | 0.182 |
| | 90 | 18 | 1.1 | 0.6 | 32 500 | 26 300 | — | 10 400 | 13 800 | 29.9 | 62 | 83 | 1 | 0.391 |

**Notes**
(1) For applications operating near the limiting speed, refer to Page **B079**.
(2) The suffixes A, A5, B, and C represent contact angles of 30°, 25°, 40°, and 15° respectively.
(3) For bearings marked — in the column for $d_b$, $d_b$ and $r_b$ for shafts are $d_a$ (min.) and $r_a$ (max.) respectively.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| Contact Angle | $if_oF_a^*/C_{or}$ | e | Single, DT | | | | DB or DF | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $F_a/F_r \le e$ | | $F_a/F_r > e$ | | $F_a/F_r \le e$ | | $F_a/F_r > e$ | |
| | | | X | Y | X | Y | X | Y | X | Y |
| 15° | 0.178 | 0.38 | 1 | 0 | 0.44 | 1.47 | 1 | 1.65 | 0.72 | 2.39 |
| | 0.357 | 0.40 | 1 | 0 | 0.44 | 1.40 | 1 | 1.57 | 0.72 | 2.28 |
| | 0.714 | 0.43 | 1 | 0 | 0.44 | 1.30 | 1 | 1.46 | 0.72 | 2.11 |
| | 1.07 | 0.46 | 1 | 0 | 0.44 | 1.23 | 1 | 1.38 | 0.72 | 2.00 |
| | 1.43 | 0.47 | 1 | 0 | 0.44 | 1.19 | 1 | 1.34 | 0.72 | 1.93 |
| | 2.14 | 0.50 | 1 | 0 | 0.44 | 1.12 | 1 | 1.26 | 0.72 | 1.82 |
| | 3.57 | 0.55 | 1 | 0 | 0.44 | 1.02 | 1 | 1.14 | 0.72 | 1.66 |
| | 5.35 | 0.56 | 1 | 0 | 0.44 | 1.00 | 1 | 1.12 | 0.72 | 1.63 |
| 25° | — | 0.68 | 1 | 0 | 0.41 | 0.87 | 1 | 0.92 | 0.67 | 1.41 |
| 30° | — | 0.80 | 1 | 0 | 0.39 | 0.76 | 1 | 0.78 | 0.63 | 1.24 |
| 40° | — | 1.14 | 1 | 0 | 0.35 | 0.57 | 1 | 0.55 | 0.57 | 0.93 |

*For i, use 2 for DB, DF and 1 for DT

## Static Equivalent Load $P_o=X_oF_r+Y_oF_a$

| Contact Angle | Single, DT | | DB or DF | |
|---|---|---|---|---|
| | $X_o$ | $Y_o$ | $X_o$ | $Y_o$ |
| 15° | 0.5 | 0.46 | 1 | 0.92 |
| 25° | 0.5 | 0.38 | 1 | 0.76 |
| 30° | 0.5 | 0.33 | 1 | 0.66 |
| 40° | 0.5 | 0.26 | 1 | 0.52 |

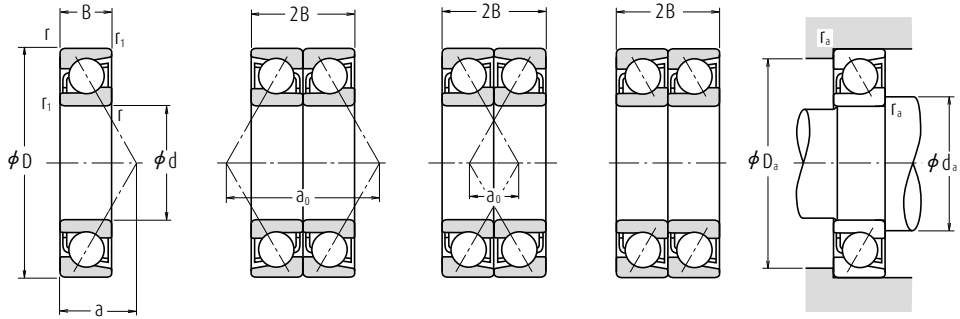
Single or DT mounting
When $F_r > 0.5F_r+Y_oF_a$
use $P_o=F_r$

| Bearing Numbers (2) Cage Symbol (4) | | | | | | Basic Load Ratings (Matched) (N) | | Limiting Speeds (1) (Matched) ($min^{-1}$) | | Load Center Spacings (mm) | | Abutment and Fillet Dimensions (mm) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Single | Standard | Option | Duplex | | | $C_r$ | $C_{0r}$ | Grease | Oil | $a_0$ DB | $a_0$ DF | $d_b$ (3) min. | $D_b$ max. | $r_b$ (3) max. |
| 7208 BEA* | T85 | MR, T7 | | | | — | — | 6 000 | 8 500 | 68.3 | 32.3 | 45 | 75 | 0.6 |
| 7208 C* | (M) | W,T,TYN | DB | DF | DT | 59 000 | 50 500 | 11 000 | 15 000 | 34.1 | 1.9 | — | 75 | 0.6 |
| 7308 A | W | (M), T | DB | DF | DT | 79 500 | 66 000 | 5 600 | 7 500 | 60.5 | 14.5 | 46 | 84 | 1 |
| 7308 BEA | W | MR, T7 | DB | DF | DT | 68 500 | 65 500 | 4 000 | 5 300 | 85.8 | 35.8 | 51 | 94 | 1 |
| 7308 BEA* | T85 | MR, T7 | — | — | — | — | — | 5 600 | 8 000 | 77.5 | 31.5 | 46 | 84 | 1 |
| 7909 A5* | (M) | T,TYN | DB | DF | DT | 24 600 | 25 400 | 9 500 | 13 000 | 38.4 | 14.4 | — | 65.5 | 0.3 |
| 7909 C* | (M) | T, TYN | DB | DF | DT | 26 000 | 26 800 | 12 000 | 16 000 | 27.1 | 3.1 | — | 65.5 | 0.3 |
| 7009 A* | W | (M), TYN | DB | DF | DT | 37 500 | 37 500 | 7 500 | 10 000 | 50.6 | 18.6 | 50 | 70 | 0.6 |
| 7009 C* | (M) | W,TYN | DB | DF | DT | 39 500 | 38 500 | 11 000 | 15 000 | 32.1 | 0.1 | — | 70 | 0.6 |
| 7209 A* | W | (M), T,TYN | DB | DF | DT | 64 500 | 57 500 | 7 100 | 9 500 | 56.5 | 18.5 | 50 | 80 | 0.6 |
| 7209 B | W | (M),T | DB | DF | DT | 58 500 | 52 500 | 5 000 | 6 700 | 73.5 | 35.5 | 50 | 80 | 0.6 |
| 7209 BEA* | T85 | MR, T7 | — | — | — | — | — | 5 600 | 8 000 | 73.5 | 35.5 | 50 | 80 | 0.6 |
| 7209 C* | (M) | W,T, TYN | DB | DF | DT | 66 500 | 57 500 | 10 000 | 14 000 | 36.4 | 1.6 | — | 80 | 0.6 |
| 7309 A | W | (M), T | DB | DF | DT | 103 000 | 87 000 | 5 000 | 6 700 | 66.9 | 16.9 | 51 | 94 | 1 |
| 7309 BEA | W | MR, T7 | DB | DF | DT | 102 000 | 79 500 | 3 600 | 4 800 | 85.8 | 35.8 | 51 | 94 | 1 |
| 7309 BEA* | T85 | MR, T7 | — | — | — | — | — | 5 000 | 7 100 | 85.8 | 35.8 | 51 | 94 | 1 |
| 7910 A5* | (M) | T,TYN | DB | DF | DT | 25 900 | 28 400 | 9 000 | 12 000 | 40.5 | 16.5 | — | 69.5 | 0.3 |
| 7910 C* | (M) | T, TYN | DB | DF | DT | 27 400 | 30 000 | 11 000 | 15 000 | 28.3 | 4.3 | — | 69.5 | 0.3 |
| 7010 A* | W | (M), T,TYN | DB | DF | DT | 40 000 | 42 000 | 7 100 | 9 500 | 53.5 | 21.5 | 55 | 75 | 0.6 |
| 7010 C* | (M) | W,T, TYN | DB | DF | DT | 42 000 | 44 000 | 10 000 | 14 000 | 33.4 | 1.4 | — | 75 | 0.6 |
| 7210 A* | W | (M), T,TYN | DB | DF | DT | 67 000 | 63 000 | 6 300 | 9 000 | 60.4 | 20.4 | 55 | 85 | 0.6 |
| 7210 B | W | (M),T | DB | DF | DT | 60 500 | 57 000 | 4 500 | 6 300 | 78.7 | 38.7 | 55 | 85 | 0.6 |
| 7210 BEA* | T85 | MR, T7 | — | — | — | — | — | 5 000 | 7 500 | 78.7 | 38.7 | 55 | 85 | 0.6 |
| 7210 C* | (M) | W,T,TYN | DB | DF | DT | 69 500 | 63 500 | 9 500 | 13 000 | 38.7 | 1.3 | — | 85 | 0.6 |
| 7310 A | W | (M), T | DB | DF | DT | 121 000 | 104 000 | 4 500 | 6 000 | 73.2 | 19.2 | 56 | 104 | 1 |
| 7310 BEA | W | MR, T7 | DB | DF | DT | 127 000 | 101 000 | 3 200 | 4 500 | 94.1 | 40.1 | 56 | 104 | 1 |
| 7310 BEA* | T85 | MR, T7 | — | — | — | — | — | 4 500 | 6 700 | 94.1 | 40.1 | 56 | 104 | 1 |
| 7911 A5* | (M) | T,TYN | DB | DF | DT | 29 300 | 33 500 | 8 000 | 11 000 | 44.5 | 18.5 | — | 75 | 0.6 |
| 7911 C* | (M) | T, TYN | DB | DF | DT | 31 000 | 35 500 | 9 500 | 13 000 | 31.1 | 5.1 | — | 75 | 0.6 |
| 7011 A* | W | (M), T,TYN | DB | DF | DT | 52 500 | 55 500 | 6 300 | 8 500 | 59.9 | 23.9 | 60 | 85 | 0.6 |

**Note** (4) (M) in the column of cage symbols are usually omitted from the bearing number.

**Remark** The bearings denoted by an asterisk (*) are NSKHPS Angular contact ball bearings and the column of Duplex in Bearing Numbers indicates the universal matching.

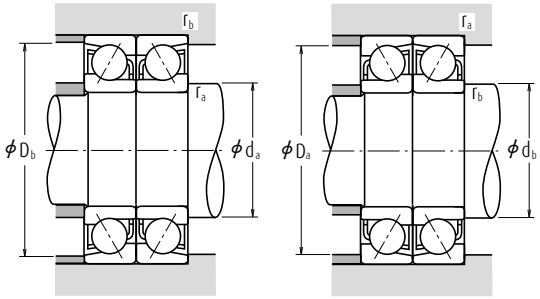
## Single/matched mountings
## Bore Diameter 55 – 65 mm




Single | Back-to-Back DB | Face-to-Face DF | Tandem DT

| Boundary Dimensions (mm) | | | | | Basic Load Ratings (Single) (N) | | Factor | Limiting Speeds (1) ($min^{-1}$) | | Eff.Load Centers (mm) | Abutment and Fillet Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d | D | B | r min. | $r_1$ min. | $C_r$ | $C_{0r}$ | $f_0$ | Grease | Oil | a | $d_a$ min. | $D_a$ max. | $r_a$ max. | approx. |
| **55** | 90 | 18 | 1.1 | 0.6 | 36 000 | 28 600 | 15.5 | 15 900 | 24 200 | 18.7 | 62 | 83 | 1 | 0.43 |
| | 100 | 21 | 1.5 | 1 | 51 000 | 37 000 | — | 9 700 | 13 000 | 32.9 | 64 | 91 | 1.5 | 0.613 |
| | 100 | 21 | 1.5 | 1 | 46 500 | 36 000 | — | 5 300 | 7 100 | 43.0 | 64 | 91 | 1.5 | 0.627 |
| | 100 | 21 | 1.5 | 1 | 51 500 | 37 000 | — | 6 000 | 8 500 | 43.0 | 64 | 91 | 1.5 | 0.596 |
| | 100 | 21 | 1.5 | 1 | 55 500 | 40 000 | 14.5 | 14 900 | 22 600 | 20.9 | 64 | 91 | 1.5 | 0.688 |
| | 120 | 29 | 2 | 1 | 86 000 | 61 500 | — | 5 000 | 6 700 | 39.8 | 65 | 110 | 2 | 1.41 |
| | 120 | 29 | 2 | 1 | 89 000 | 58 500 | — | 3 600 | 5 000 | 51.2 | 65 | 110 | 2 | 1.42 |
| | 120 | 29 | 2 | 1 | 89 000 | 58 500 | — | 5 000 | 7 500 | 51.2 | 65 | 110 | 2 | 1.36 |
| **60** | 85 | 13 | 1 | 0.6 | 19 200 | 17 700 | — | 13 800 | 20 700 | 23.4 | 66 | 79 | 1 | 0.197 |
| | 85 | 13 | 1 | 0.6 | 20 400 | 18 700 | 16.5 | 15 900 | 24 200 | 16.2 | 66 | 79 | 1 | 0.194 |
| | 95 | 18 | 1.1 | 0.6 | 33 500 | 28 100 | — | 9 700 | 13 000 | 31.4 | 67 | 88 | 1 | 0.417 |
| | 95 | 18 | 1.1 | 0.6 | 37 000 | 30 500 | 15.7 | 14 900 | 22 600 | 19.4 | 67 | 88 | 1 | 0.46 |
| | 110 | 22 | 1.5 | 1 | 62 000 | 45 500 | — | 8 900 | 11 800 | 35.5 | 69 | 101 | 1.5 | 0.798 |
| | 110 | 22 | 1.5 | 1 | 56 000 | 44 500 | — | 4 800 | 6 300 | 46.7 | 69 | 101 | 1.5 | 0.815 |
| | 110 | 22 | 1.5 | 1 | 61 500 | 45 000 | — | 5 300 | 7 500 | 46.7 | 69 | 101 | 1.5 | 0.791 |
| | 110 | 22 | 1.5 | 1 | 67 500 | 49 000 | 14.4 | 13 600 | 20 600 | 22.4 | 69 | 101 | 1.5 | 0.889 |
| | 130 | 31 | 2.1 | 1.1 | 98 000 | 71 500 | — | 4 800 | 6 300 | 42.9 | 72 | 118 | 2 | 1.74 |
| | 130 | 31 | 2.1 | 1.1 | 102 000 | 68 500 | — | 3 400 | 4 500 | 55.4 | 72 | 118 | 2 | 1.77 |
| | 130 | 31 | 2.1 | 1.1 | 102 000 | 68 500 | — | 4 800 | 6 700 | 55.4 | 72 | 118 | 2 | 1.7 |
| **65** | 90 | 13 | 1 | 0.6 | 20 000 | 19 400 | — | 13 000 | 19 400 | 24.6 | 71 | 84 | 1 | 0.211 |
| | 90 | 13 | 1 | 0.6 | 21 200 | 20 500 | 16.7 | 14 900 | 22 600 | 16.9 | 71 | 84 | 1 | 0.208 |
| | 100 | 18 | 1.1 | 0.6 | 33 500 | 31 500 | — | 9 100 | 12 200 | 32.8 | 72 | 93 | 1 | 0.455 |
| | 100 | 18 | 1.1 | 0.6 | 39 000 | 34 500 | 15.9 | 14 000 | 21 300 | 20.0 | 72 | 93 | 1 | 0.493 |
| | 120 | 23 | 1.5 | 1 | 70 500 | 54 000 | — | 8 200 | 10 900 | 38.2 | 74 | 111 | 1.5 | 1.03 |
| | 120 | 23 | 1.5 | 1 | 63 500 | 52 500 | — | 4 300 | 6 000 | 50.3 | 74 | 111 | 1.5 | 1.05 |
| | 120 | 23 | 1.5 | 1 | 70 000 | 53 500 | — | 4 800 | 7 100 | 50.3 | 74 | 111 | 1.5 | 1.01 |
| | 120 | 23 | 1.5 | 1 | 77 000 | 58 500 | 14.6 | 12 500 | 19 000 | 23.9 | 74 | 111 | 1.5 | 1.14 |
| | 140 | 33 | 2.1 | 1.1 | 111 000 | 82 000 | — | 4 300 | 6 000 | 46.1 | 77 | 128 | 2 | 2.12 |
| | 140 | 33 | 2.1 | 1.1 | 114 000 | 77 000 | — | 3 200 | 4 300 | 59.5 | 77 | 128 | 2 | 2.17 |
| | 140 | 33 | 2.1 | 1.1 | 114 000 | 77 000 | — | 4 300 | 6 300 | 59.5 | 77 | 128 | 2 | 2.09 |

**Notes** (1) For applications operating near the limiting speed, refer to Page **B079**.
(2) The suffixes A, A5, B, and C represent contact angles of 30°, 25°, 40°, and 15° respectively.
(3) For bearings marked — in the column for $d_b$, $d_b$ and $r_b$ for shafts are $d_a$ (min.) and $r_a$ (max.) respectively.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| Contact Angle | $if_oF_a^*/C_{or}$ | e | Single, DT | | | | DB or DF | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $F_a/F_r \le e$ | | $F_a/F_r > e$ | | $F_a/F_r \le e$ | | $F_a/F_r > e$ | |
| | | | X | Y | X | Y | X | Y | X | Y |
| 15° | 0.178 | 0.38 | 1 | 0 | 0.44 | 1.47 | 1 | 1.65 | 0.72 | 2.39 |
| | 0.357 | 0.40 | 1 | 0 | 0.44 | 1.40 | 1 | 1.57 | 0.72 | 2.28 |
| | 0.714 | 0.43 | 1 | 0 | 0.44 | 1.30 | 1 | 1.46 | 0.72 | 2.11 |
| | 1.07 | 0.46 | 1 | 0 | 0.44 | 1.23 | 1 | 1.38 | 0.72 | 2.00 |
| | 1.43 | 0.47 | 1 | 0 | 0.44 | 1.19 | 1 | 1.34 | 0.72 | 1.93 |
| | 2.14 | 0.50 | 1 | 0 | 0.44 | 1.12 | 1 | 1.26 | 0.72 | 1.82 |
| | 3.57 | 0.55 | 1 | 0 | 0.44 | 1.02 | 1 | 1.14 | 0.72 | 1.66 |
| | 5.35 | 0.56 | 1 | 0 | 0.44 | 1.00 | 1 | 1.12 | 0.72 | 1.63 |
| 25° | — | 0.68 | 1 | 0 | 0.41 | 0.87 | 1 | 0.92 | 0.67 | 1.41 |
| 30° | — | 0.80 | 1 | 0 | 0.39 | 0.76 | 1 | 0.78 | 0.63 | 1.24 |
| 40° | — | 1.14 | 1 | 0 | 0.35 | 0.57 | 1 | 0.55 | 0.57 | 0.93 |

*For i, use 2 for DB, DF and 1 for DT

## Static Equivalent Load $P_o=X_oF_r+Y_oF_a$

| Contact Angle | Single, DT | | DB or DF | |
|---|---|---|---|---|
| | $X_o$ | $Y_o$ | $X_o$ | $Y_o$ |
| 15° | 0.5 | 0.46 | 1 | 0.92 |
| 25° | 0.5 | 0.38 | 1 | 0.76 |
| 30° | 0.5 | 0.33 | 1 | 0.66 |
| 40° | 0.5 | 0.26 | 1 | 0.52 |

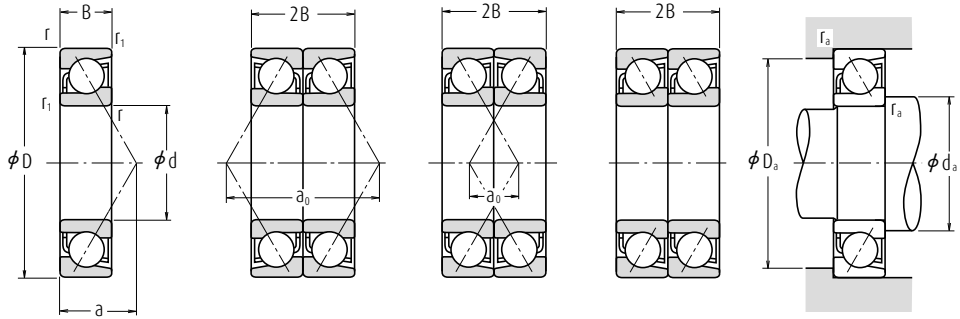
Single or DT mounting
When $F_r > 0.5F_r+Y_oF_a$
use $P_o=F_r$

| Bearing Numbers (2) Cage Symbol (4) | | | | | | Basic Load Ratings (Matched) (N) | | Limiting Speeds (1) (Matched) ($min^{-1}$) | | Load Center Spacings (mm) | | Abutment and Fillet Dimensions (mm) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | $a_0$ | | | | |
| Single | Standard | Option | Duplex | | | $C_r$ | $C_{0r}$ | Grease | Oil | DB | DF | $d_b$ (3) min. | $D_b$ max. | $r_b$ (3) max. |
| 7011 C* | (M) | W,T, TYN | DB | DF | DT | 55 500 | 57 500 | 9 000 | 12 000 | 37.4 | 1.4 | — | 85 | 0.6 |
| 7211 A* | W | (M), T,TYN | DB | DF | DT | 83 000 | 79 000 | 6 000 | 8 000 | 65.7 | 23.7 | 61 | 94 | 1 |
| 7211 B | W | (M),T | DB | DF | DT | 75 000 | 72 000 | 4 000 | 5 600 | 86.0 | 44.0 | 61 | 94 | 1 |
| 7211 BEA* | T85 | MR, T7 | | | | — | — | 4 500 | 6 700 | 86.0 | 44.0 | 61 | 94 | 1 |
| 7211 C* | (M) | W,T,TYN | DB | DF | DT | 86 000 | 80 000 | 8 500 | 12 000 | 41.7 | 0.3 | — | 94 | 1 |
| 7311 A | W | (M), T | DB | DF | DT | 139 000 | 123 000 | 4 000 | 5 600 | 79.5 | 21.5 | 61 | 114 | 1 |
| 7311 BEA | W | MR, T7 | DB | DF | DT | 145 000 | 117 000 | 3 000 | 4 000 | 102.4 | 44.4 | 61 | 114 | 1 |
| 7311 BEA* | T85 | MR, T7 | — | — | — | — | — | 4 000 | 6 000 | 102.4 | 44.4 | 61 | 114 | 1 |
| 7912 A5* | (M) | T,TYN | DB | DF | DT | 29 800 | 35 500 | 7 500 | 10 000 | 46.8 | 20.8 | — | 80 | 0.6 |
| 7912 C* | (M) | T, TYN | DB | DF | DT | 31 500 | 37 500 | 9 000 | 12 000 | 32.4 | 6.4 | — | 80 | 0.6 |
| 7012 A* | W | (M), T,TYN | DB | DF | DT | 53 500 | 59 000 | 6 000 | 8 000 | 62.7 | 26.7 | 65 | 90 | 0.6 |
| 7012 C* | (M) | W,T, TYN | DB | DF | DT | 57 000 | 61 500 | 8 500 | 12 000 | 38.8 | 2.8 | — | 90 | 0.6 |
| 7212 A* | W | (M), T,TYN | DB | DF | DT | 100 000 | 97 500 | 5 300 | 7 100 | 71.1 | 27.1 | 66 | 104 | 1 |
| 7212 B | W | (M),T | DB | DF | DT | 91 000 | 89 000 | 3 800 | 5 300 | 93.3 | 49.3 | 66 | 104 | 1 |
| 7212 BEA* | T85 | MR, T7 | — | — | — | — | — | 4 300 | 6 000 | 93.3 | 49.3 | 66 | 104 | 1 |
| 7212 C* | (M) | W,T,TYN | DB | DF | DT | 104 000 | 98 500 | 7 500 | 11 000 | 44.8 | 0.8 | — | 104 | 1 |
| 7312 A | W | (M), T | DB | DF | DT | 159 000 | 143 000 | 3 800 | 5 000 | 85.9 | 23.9 | 67 | 123 | 1 |
| 7312 BEA | W | MR, T7 | DB | DF | DT | 166 000 | 137 000 | 2 600 | 3 800 | 110.7 | 48.7 | 67 | 123 | 1 |
| 7312 BEA* | T85 | MR, T7 | — | — | — | — | — | 3 800 | 5 600 | 110.7 | 48.7 | 67 | 123 | 1 |
| 7913 A5* | (M) | T,TYN | DB | DF | DT | 31 000 | 39 000 | 7 100 | 9 500 | 49.1 | 23.1 | — | 85 | 0.6 |
| 7913 C* | (M) | T, TYN | DB | DF | DT | 33 000 | 41 000 | 8 500 | 12 000 | 33.8 | 7.8 | — | 85 | 0.6 |
| 7013 A* | W | (M), T,TYN | DB | DF | DT | 56 500 | 65 500 | 5 600 | 7 500 | 65.6 | 29.6 | 70 | 95 | 0.6 |
| 7013 C* | (M) | W,T, TYN | DB | DF | DT | 60 500 | 68 500 | 8 000 | 11 000 | 40.1 | 4.1 | — | 95 | 0.6 |
| 7213 A* | W | (M), T,TYN | DB | DF | DT | 114 000 | 116 000 | 4 800 | 6 700 | 76.4 | 30.4 | 71 | 114 | 1 |
| 7213 B | W | (M),T | DB | DF | DT | 103 000 | 105 000 | 3 400 | 4 800 | 100.6 | 54.6 | 71 | 114 | 1 |
| 7213 BEA* | T85 | MR, T7 | — | — | — | — | — | 3 800 | 5 600 | 100.6 | 54.6 | 71 | 114 | 1 |
| 7213 C* | (M) | W,T,TYN | DB | DF | DT | 119 000 | 117 000 | 7 100 | 9 500 | 47.8 | 1.8 | — | 114 | 1 |
| 7313 A | W | (M), T | DB | DF | DT | 180 000 | 164 000 | 3 600 | 4 800 | 92.2 | 26.2 | 72 | 133 | 1 |
| 7313 BEA | W | MR, T7 | DB | DF | DT | 184 000 | 154 000 | 2 400 | 3 400 | 119.0 | 53.0 | 72 | 133 | 1 |
| 7313 BEA* | T85 | MR, T7 | — | — | — | — | — | 3 600 | 5 000 | 119.0 | 53.0 | 72 | 133 | 1 |

**Note** (4) (M) in the column of cage symbols are usually omitted from the bearing number.

**Remark** The bearings denoted by an asterisk (*) are NSKHPS Angular contact ball bearings and the column of Duplex in Bearing Numbers indicates the universal matching.

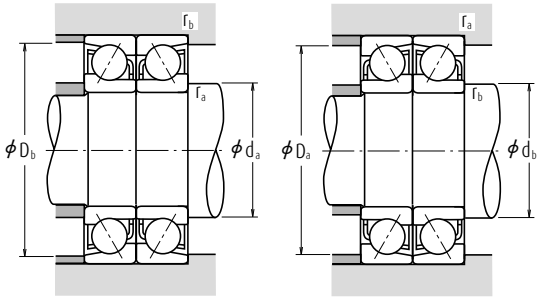
## Single/matched mountings
## Bore Diameter 70 – 80 mm




Single | Back-to-Back DB | Face-to-Face DF | Tandem DT

| Boundary Dimensions (mm) | | | | | Basic Load Ratings (Single) (N) | | Factor | Limiting Speeds (1) (min-1) | | Eff.Load Centers (mm) | Abutment and Fillet Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d | D | B | r min. | r1 min. | Cr | C0r | f0 | Grease | Oil | a | da min. | Da max. | ra max. | approx. |
| **70** | 100 | 16 | 1 | 0.6 | 27 900 | 26 300 | — | 11 800 | 17 700 | 27.8 | 76 | 94 | 1 | 0.341 |
| | 100 | 16 | 1 | 0.6 | 29 500 | 27 800 | 16.4 | 13 600 | 20 600 | 19.4 | 76 | 94 | 1 | 0.338 |
| | 110 | 20 | 1.1 | 0.6 | 45 000 | 39 500 | — | 8 400 | 11 200 | 36.0 | 77 | 103 | 1 | 0.625 |
| | 110 | 20 | 1.1 | 0.6 | 49 000 | 43 000 | 15.7 | 12 800 | 19 500 | 22.1 | 77 | 103 | 1 | 0.698 |
| | 125 | 24 | 1.5 | 1 | 77 000 | 59 500 | — | 7 700 | 10 300 | 40.1 | 79 | 116 | 1.5 | 1.11 |
| | 125 | 24 | 1.5 | 1 | 69 000 | 58 000 | — | 4 000 | 5 600 | 52.9 | 79 | 116 | 1.5 | 1.14 |
| | 125 | 24 | 1.5 | 1 | 75 500 | 58 500 | — | 4 500 | 6 700 | 52.9 | 79 | 116 | 1.5 | 1.08 |
| | 125 | 24 | 1.5 | 1 | 83 500 | 64 500 | 14.6 | 11 800 | 18 000 | 25.1 | 79 | 116 | 1.5 | 1.24 |
| | 150 | 35 | 2.1 | 1.1 | 125 000 | 93 500 | — | 4 000 | 5 300 | 49.3 | 82 | 138 | 2 | 2.6 |
| | 150 | 35 | 2.1 | 1.1 | 124 000 | 87 500 | — | 2 800 | 4 000 | 63.6 | 82 | 138 | 2 | 2.62 |
| | 150 | 35 | 2.1 | 1.1 | 124 000 | 87 500 | — | 4 000 | 6 000 | 63.7 | 82 | 138 | 2 | 2.53 |
| **75** | 105 | 16 | 1 | 0.6 | 28 300 | 27 700 | — | 11 200 | 16 700 | 29.0 | 81 | 99 | 1 | 0.355 |
| | 105 | 16 | 1 | 0.6 | 30 000 | 29 300 | 16.6 | 12 800 | 19 500 | 20.1 | 81 | 99 | 1 | 0.357 |
| | 115 | 20 | 1.1 | 0.6 | 46 000 | 41 500 | — | 7 900 | 10 600 | 37.4 | 82 | 108 | 1 | 0.661 |
| | 115 | 20 | 1.1 | 0.6 | 50 500 | 45 500 | 15.9 | 12 200 | 18 500 | 22.7 | 82 | 108 | 1 | 0.748 |
| | 130 | 25 | 1.5 | 1 | 80 000 | 64 500 | — | 7 400 | 9 800 | 42.1 | 84 | 121 | 1.5 | 1.19 |
| | 130 | 25 | 1.5 | 1 | 68 500 | 58 500 | — | 3 800 | 5 300 | 55.5 | 84 | 121 | 1.5 | 1.22 |
| | 130 | 25 | 1.5 | 1 | 78 500 | 63 500 | — | 4 300 | 6 300 | 55.5 | 84 | 121 | 1.5 | 1.18 |
| | 130 | 25 | 1.5 | 1 | 87 000 | 70 000 | 14.8 | 11 300 | 17 100 | 26.2 | 84 | 121 | 1.5 | 1.36 |
| | 160 | 37 | 2.1 | 1.1 | 136 000 | 106 000 | — | 3 800 | 5 000 | 52.4 | 87 | 148 | 2 | 3.13 |
| | 160 | 37 | 2.1 | 1.1 | 134 000 | 98 500 | — | 2 800 | 3 800 | 67.8 | 87 | 148 | 2 | 3.13 |
| | 160 | 37 | 2.1 | 1.1 | 134 000 | 98 500 | — | 3 800 | 5 600 | — | — | — | — | — |
| **80** | 110 | 16 | 1 | 0.6 | 28 700 | 29 000 | — | 10 600 | 15 800 | 30.2 | 86 | 104 | 1 | 0.38 |
| | 110 | 16 | 1 | 0.6 | 30 500 | 30 500 | 16.7 | 12 200 | 18 500 | 20.7 | 86 | 104 | 1 | 0.376 |
| | 125 | 22 | 1.1 | 0.6 | 56 000 | 50 500 | — | 7 400 | 9 800 | 40.6 | 87 | 118 | 1 | 0.88 |
| | 125 | 22 | 1.1 | 0.6 | 61 500 | 55 500 | 15.7 | 11 300 | 17 100 | 24.7 | 87 | 118 | 1 | 0.966 |
| | 140 | 26 | 2 | 1 | 89 500 | 71 500 | — | 6 900 | 9 100 | 44.8 | 90 | 130 | 2 | 1.46 |
| | 140 | 26 | 2 | 1 | 80 500 | 69 500 | — | 3 600 | 5 000 | 59.1 | 90 | 130 | 2 | 1.49 |
| | 140 | 26 | 2 | 1 | 87 500 | 70 000 | — | 4 000 | 6 000 | 59.2 | 87 | 148 | 2 | 1.42 |
| | 140 | 26 | 2 | 1 | 97 500 | 77 500 | 14.7 | 10 500 | 16 000 | 27.7 | 90 | 130 | 2 | 1.63 |
| | 170 | 39 | 2.1 | 1.1 | 147 000 | 119 000 | — | 3 600 | 4 800 | 55.6 | 92 | 158 | 2 | 3.71 |
| | 170 | 39 | 2.1 | 1.1 | 144 000 | 110 000 | — | 2 600 | 3 400 | 71.9 | 92 | 158 | 2 | 3.84 |
| | 170 | 39 | 2.1 | 1.1 | 144 000 | 110 000 | — | 3 600 | 5 300 | — | — | — | — | — |

**Notes**
(1) For applications operating near the limiting speed, refer to Page **B079**.
(2) The suffixes A, A5, B, and C represent contact angles of 30°, 25°, 40°, and 15° respectively.
(3) For bearings marked — in the column for $d_b$, $d_b$ and $r_b$ for shafts are $d_a$ (min.) and $r_a$ (max.) respectively.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| Contact Angle | $if_oF_a^*/C_{or}$ | e | Single, DT | | | | DB or DF | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $F_a/F_r \le e$ | | $F_a/F_r > e$ | | $F_a/F_r \le e$ | | $F_a/F_r > e$ | |
| | | | X | Y | X | Y | X | Y | X | Y |
| 15° | 0.178 | 0.38 | 1 | 0 | 0.44 | 1.47 | 1 | 1.65 | 0.72 | 2.39 |
| | 0.357 | 0.40 | 1 | 0 | 0.44 | 1.40 | 1 | 1.57 | 0.72 | 2.28 |
| | 0.714 | 0.43 | 1 | 0 | 0.44 | 1.30 | 1 | 1.46 | 0.72 | 2.11 |
| | 1.07 | 0.46 | 1 | 0 | 0.44 | 1.23 | 1 | 1.38 | 0.72 | 2.00 |
| | 1.43 | 0.47 | 1 | 0 | 0.44 | 1.19 | 1 | 1.34 | 0.72 | 1.93 |
| | 2.14 | 0.50 | 1 | 0 | 0.44 | 1.12 | 1 | 1.26 | 0.72 | 1.82 |
| | 3.57 | 0.55 | 1 | 0 | 0.44 | 1.02 | 1 | 1.14 | 0.72 | 1.66 |
| | 5.35 | 0.56 | 1 | 0 | 0.44 | 1.00 | 1 | 1.12 | 0.72 | 1.63 |
| 25° | — | 0.68 | 1 | 0 | 0.41 | 0.87 | 1 | 0.92 | 0.67 | 1.41 |
| 30° | — | 0.80 | 1 | 0 | 0.39 | 0.76 | 1 | 0.78 | 0.63 | 1.24 |
| 40° | — | 1.14 | 1 | 0 | 0.35 | 0.57 | 1 | 0.55 | 0.57 | 0.93 |

*For i, use 2 for DB, DF and 1 for DT

## Static Equivalent Load $P_o=X_oF_r+Y_oF_a$

| Contact Angle | Single, DT | | DB or DF | |
|---|---|---|---|---|
| | $X_o$ | $Y_o$ | $X_o$ | $Y_o$ |
| 15° | 0.5 | 0.46 | 1 | 0.92 |
| 25° | 0.5 | 0.38 | 1 | 0.76 |
| 30° | 0.5 | 0.33 | 1 | 0.66 |
| 40° | 0.5 | 0.26 | 1 | 0.52 |

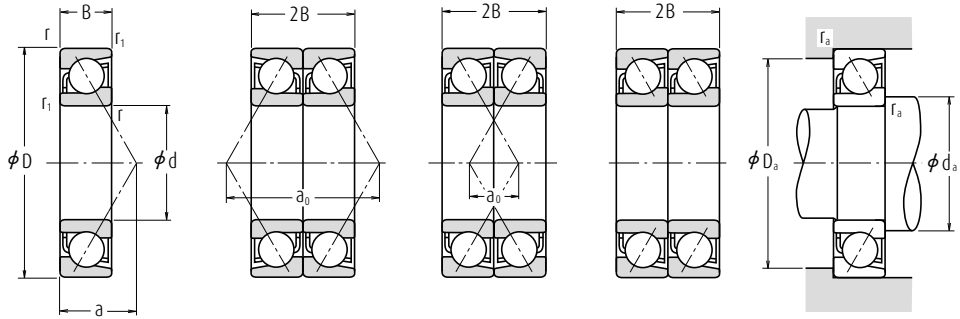
Single or DT mounting
When $F_r > 0.5F_r+Y_oF_a$ use $P_o=F_r$

| Bearing Numbers (2) Cage Symbol (4) | | | | | | Basic Load Ratings (Matched) (N) | | Limiting Speeds (1) (Matched) ($min^{-1}$) | | Load Center Spacings (mm) | | Abutment and Fillet Dimensions (mm) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | $a_0$ | | | | |
| Single | Standard | Option | Duplex | | | $C_r$ | $C_{0r}$ | Grease | Oil | DB | DF | $d_b$ (3) min. | $D_b$ max. | $r_b$ (3) max. |
| 7914 A5* | (M) | T,TYN | DB | DF | DT | 43 000 | 52 500 | 6 300 | 9 000 | 55.6 | 23.6 | — | 95 | 0.6 |
| 7914 C* | (M) | T, TYN,T85 | DB | DF | DT | 45 500 | 55 500 | 7 500 | 11 000 | 38.8 | 6.8 | — | 95 | 0.6 |
| 7014 A* | W | (M), T,TYN | DB | DF | DT | 71 500 | 82 500 | 5 000 | 6 700 | 72.0 | 32.0 | 75 | 105 | 0.6 |
| 7014 C* | (M) | W,T, TYN | DB | DF | DT | 76 000 | 86 000 | 7 100 | 10 000 | 44.1 | 4.1 | — | 105 | 0.6 |
| 7214 A* | W | (M), T,TYN | DB | DF | DT | 124 000 | 127 000 | 4 500 | 6 300 | 80.3 | 32.3 | 76 | 119 | 1 |
| 7214 B | W | (M),T | DB | DF | DT | 112 000 | 116 000 | 3 200 | 4 500 | 105.8 | 57.8 | 76 | 119 | 1 |
| 7214 BEA* | T85 | MR, T7 | — | — | — | — | — | 3 600 | 5 300 | 105.8 | 57.8 | 76 | 119 | 1 |
| 7214 C* | (M) | W,T,TYN,T7 | DB | DF | DT | 129 000 | 129 000 | 6 700 | 9 000 | 50.1 | 2.1 | — | 119 | 1 |
| 7314 A | W | (M), T | DB | DF | DT | 203 000 | 187 000 | 3 200 | 4 300 | 98.5 | 28.5 | 77 | 143 | 1 |
| 7314 BEA | W | MR, T7 | DB | DF | DT | 201 000 | 175 000 | 2 400 | 3 200 | 127.3 | 57.3 | 77 | 143 | 1 |
| 7314 BEA* | T85 | MR, T7 | — | — | — | — | — | 3 200 | 4 800 | 127.3 | 57.3 | 77 | 143 | 1 |
| 7915 A5* | (M) | TYN | DB | DF | DT | 44 000 | 55 500 | 6 000 | 8 500 | 58.0 | 26.0 | — | 100 | 0.6 |
| 7915 C* | (M) | T, TYN | DB | DF | DT | 46 500 | 58 500 | 7 100 | 10 000 | 40.1 | 8.1 | — | 100 | 0.6 |
| 7015 A* | W | (M), T,TYN | DB | DF | DT | 73 000 | 87 500 | 4 800 | 6 700 | 74.8 | 34.8 | 80 | 110 | 0.6 |
| 7015 C* | (M) | W,T, TYN | DB | DF | DT | 78 000 | 91 500 | 6 700 | 9 500 | 45.4 | 5.4 | — | 110 | 0.6 |
| 7215 A* | W | (M), T,TYN | DB | DF | DT | 123 000 | 129 000 | 4 300 | 6 000 | 84.2 | 34.2 | 81 | 124 | 1 |
| 7215 B | W | (M),T | DB | DF | DT | 112 000 | 117 000 | 3 200 | 4 300 | 111.0 | 61.0 | 81 | 124 | 1 |
| 7215 BEA* | T85 | MR | — | — | — | — | — | 3 600 | 5 000 | 111.0 | 61.0 | 81 | 124 | 1 |
| 7215 C* | (M) | W,T,TYN,T7 | DB | DF | DT | 134 000 | 140 000 | 6 300 | 9 000 | 52.4 | 2.4 | — | 124 | 1 |
| 7315 A | W | (M), T | DB | DF | DT | 221 000 | 212 000 | 3 000 | 4 000 | 104.8 | 30.8 | 82 | 153 | 1 |
| 7315 BEA | W | MR, T7 | DB | DF | DT | 217 000 | 197 000 | 2 200 | 3 000 | 135.6 | 61.6 | 82 | 153 | 1 |
| 7315BEA* | T85 | MR | — | — | — | — | — | 3 800 | 5 600 | — | — | — | — | — |
| 7916 A5* | (M) | T,TYN | DB | DF | DT | 44 500 | 58 000 | 5 600 | 8 000 | 60.3 | 28.3 | — | 105 | 0.6 |
| 7916 C* | (M) | T, TYN | DB | DF | DT | 47 000 | 61 500 | 6 700 | 9 500 | 41.5 | 9.5 | — | 105 | 0.6 |
| 7016 A* | W | (M), T,TYN | DB | DF | DT | 89 500 | 106 000 | 4 300 | 6 000 | 81.2 | 37.2 | 85 | 120 | 0.6 |
| 7016 C* | (M) | W,T, TYN | DB | DF | DT | 95 500 | 111 000 | 6 300 | 9 000 | 49.4 | 5.4 | — | 120 | 0.6 |
| 7216 A* | W | (M), T,TYN | DB | DF | DT | 145 000 | 152 000 | 4 000 | 5 600 | 89.5 | 37.5 | 86 | 134 | 1 |
| 7216 B | W | (M),T | DB | DF | DT | 131 000 | 139 000 | 2 800 | 4 000 | 118.3 | 66.3 | 86 | 134 | 1 |
| 7216 BEA* | T85 | MR, T7 | — | — | — | — | — | 3 200 | 4 800 | 118.3 | 66.3 | 82 | 153 | 1 |
| 7216 C* | (M) | W,T,TYN | DB | DF | DT | 151 000 | 155 000 | 6 000 | 8 000 | 55.5 | 3.5 | — | 134 | 1 |
| 7316 A | W | (M), T | DB | DF | DT | 239 000 | 238 000 | 2 800 | 3 800 | 111.2 | 33.2 | 87 | 163 | 1 |
| 7316 BEA | W | MR, T7 | DB | DF | DT | 235 000 | 220 000 | 2 000 | 2 800 | 143.9 | 65.9 | 87 | 163 | 1 |
| 7316BEA* | T85 | MR, T7, W | — | — | — | — | — | 3 600 | 5 300 | — | — | — | — | — |

**Note** (4) (M) in the column of cage symbols are usually omitted from the bearing number.

**Remark** The bearings denoted by an asterisk (*) are NSKHPS Angular contact ball bearings and the column of Duplex in Bearing Numbers indicates the universal matching.

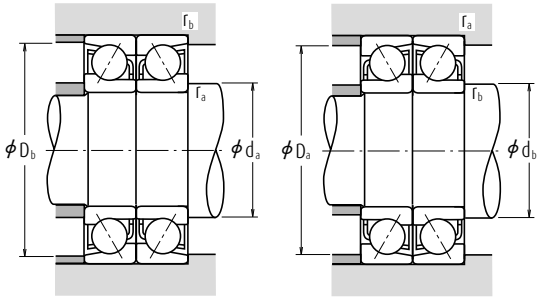
## Single/matched mountings
## Bore Diameter 85 – 100 mm




Single | Back-to-Back DB | Face-to-Face DF | Tandem DT

| Boundary Dimensions (mm) | | | | | Basic Load Ratings (Single) (N) | | Factor | Limiting Speeds (1) ($min^{-1}$) | | Eff.Load Centers (mm) | Abutment and Fillet Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d | D | B | r min. | $r_1$ min. | $C_r$ | $C_{0r}$ | $f_0$ | Grease | Oil | a | $d_a$ min. | $D_a$ max. | $r_a$ max. | approx. |
| **85** | 120 | 18 | 1.1 | 0.6 | 38 500 | 38 500 | — | 9 800 | 14 700 | 32.9 | 92 | 113 | 1 | 0.541 |
| | 120 | 18 | 1.1 | 0.6 | 41 000 | 40 500 | 16.5 | 11 300 | 17 100 | 22.7 | 92 | 113 | 1 | 0.534 |
| | 130 | 22 | 1.1 | 0.6 | 57 500 | 53 500 | — | 7 000 | 9 400 | 42.0 | 92 | 123 | 1 | 0.913 |
| | 130 | 22 | 1.1 | 0.6 | 63 000 | 58 500 | 15.9 | 10 700 | 16 300 | 25.4 | 92 | 123 | 1 | 1.01 |
| | 150 | 28 | 2 | 1 | 104 000 | 83 500 | — | 6 400 | 8 600 | 47.9 | 95 | 140 | 2 | 1.83 |
| | 150 | 28 | 2 | 1 | 93 000 | 81 000 | — | 3 400 | 4 800 | 63.3 | 95 | 140 | 2 | 1.87 |
| | 150 | 28 | 2 | 1 | 113 000 | 90 500 | 14.7 | 9 800 | 14 900 | 29.7 | 95 | 140 | 2 | 2.04 |
| | 180 | 41 | 3 | 1.1 | 159 000 | 133 000 | — | 3 400 | 4 500 | 58.8 | 99 | 166 | 2.5 | 4.33 |
| | 180 | 41 | 3 | 1.1 | 146 000 | 122 000 | — | 3 000 | 4 000 | 76.1 | 99 | 166 | 2.5 | 4.42 |
| **90** | 125 | 18 | 1.1 | 0.6 | 31 000 | 43 500 | — | 9 400 | 14 000 | 34.1 | 97 | 118 | 1 | 0.56 |
| | 125 | 18 | 1.1 | 0.6 | 44 000 | 46 000 | 16.6 | 10 700 | 16 300 | 23.4 | 97 | 118 | 1 | 0.563 |
| | 140 | 24 | 1.5 | 1 | 68 500 | 63 500 | — | 6 600 | 8 700 | 45.2 | 99 | 131 | 1.5 | 1.19 |
| | 140 | 24 | 1.5 | 1 | 75 500 | 69 000 | 15.7 | 10 000 | 15 300 | 27.4 | 99 | 131 | 1.5 | 1.34 |
| | 160 | 30 | 2 | 1 | 118 000 | 96 500 | — | 6 000 | 8 000 | 51.1 | 100 | 150 | 2 | 2.25 |
| | 160 | 30 | 2 | 1 | 107 000 | 94 000 | — | 3 200 | 4 300 | 67.4 | 100 | 150 | 2 | 2.29 |
| | 160 | 30 | 2 | 1 | 129 000 | 105 000 | 14.6 | 9 200 | 14 000 | 31.7 | 100 | 150 | 2 | 2.51 |
| | 190 | 43 | 3 | 1.1 | 171 000 | 147 000 | — | 3 200 | 4 300 | 61.9 | 104 | 176 | 2.5 | 5.06 |
| | 190 | 43 | 3 | 1.1 | 156 000 | 135 000 | — | 2 800 | 3 800 | 80.2 | 104 | 176 | 2.5 | 5.17 |
| **95** | 130 | 18 | 1.1 | 0.6 | 42 000 | 45 500 | — | 8 900 | 13 400 | 35.2 | 102 | 123 | 1 | 0.597 |
| | 130 | 18 | 1.1 | 0.6 | 44 500 | 48 000 | 16.7 | 10 300 | 15 600 | 24.1 | 102 | 123 | 1 | 0.591 |
| | 145 | 24 | 1.5 | 1 | 70 000 | 67 000 | — | 6 300 | 8 400 | 46.6 | 104 | 136 | 1.5 | 1.43 |
| | 145 | 24 | 1.5 | 1 | 77 000 | 73 000 | 15.9 | 9 600 | 14 600 | 28.1 | 104 | 136 | 1.5 | 1.42 |
| | 170 | 32 | 2.1 | 1.1 | 128 000 | 103 000 | — | 5 700 | 7 600 | 54.2 | 107 | 158 | 2 | 2.68 |
| | 170 | 32 | 2.1 | 1.1 | 116 000 | 101 000 | — | 3 000 | 4 000 | 71.6 | 107 | 158 | 2 | 2.74 |
| | 170 | 32 | 2.1 | 1.1 | 139 000 | 112 000 | 14.6 | 8 700 | 13 300 | 33.7 | 107 | 158 | 2 | 3.05 |
| | 200 | 45 | 3 | 1.1 | 183 000 | 162 000 | — | 3 000 | 4 000 | 65.1 | 109 | 186 | 2.5 | 5.83 |
| | 200 | 45 | 3 | 1.1 | 167 000 | 149 000 | — | 2 600 | 3 600 | 84.3 | 109 | 186 | 2.5 | 5.98 |
| **100** | 140 | 20 | 1.1 | 0.6 | 49 500 | 51 500 | — | 8 400 | 12 500 | 38.0 | 107 | 133 | 1 | 0.804 |
| | 140 | 20 | 1.1 | 0.6 | 52 500 | 54 000 | 16.5 | 9 600 | 14 600 | 26.1 | 107 | 133 | 1 | 0.794 |
| | 150 | 24 | 1.5 | 1 | 72 000 | 70 500 | — | 6 000 | 8 000 | 48.1 | 109 | 141 | 1.5 | 1.48 |

**Notes**
(1) For applications operating near the limiting speed, refer to Page **B079**.
(2) The suffixes A, A5, B, and C represent contact angles of 30°, 25°, 40°, and 15° respectively.
(3) For bearings marked — in the column for $d_b$, $d_b$ and $r_b$ for shafts are $d_a$ (min.) and $r_a$ (max.) respectively.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| Contact Angle | $if_oF_a^*/C_{or}$ | e | Single, DT | | | | DB or DF | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $F_a/F_r \le e$ | | $F_a/F_r > e$ | | $F_a/F_r \le e$ | | $F_a/F_r > e$ | |
| | | | X | Y | X | Y | X | Y | X | Y |
| 15° | 0.178 | 0.38 | 1 | 0 | 0.44 | 1.47 | 1 | 1.65 | 0.72 | 2.39 |
| | 0.357 | 0.40 | 1 | 0 | 0.44 | 1.40 | 1 | 1.57 | 0.72 | 2.28 |
| | 0.714 | 0.43 | 1 | 0 | 0.44 | 1.30 | 1 | 1.46 | 0.72 | 2.11 |
| | 1.07 | 0.46 | 1 | 0 | 0.44 | 1.23 | 1 | 1.38 | 0.72 | 2.00 |
| | 1.43 | 0.47 | 1 | 0 | 0.44 | 1.19 | 1 | 1.34 | 0.72 | 1.93 |
| | 2.14 | 0.50 | 1 | 0 | 0.44 | 1.12 | 1 | 1.26 | 0.72 | 1.82 |
| | 3.57 | 0.55 | 1 | 0 | 0.44 | 1.02 | 1 | 1.14 | 0.72 | 1.66 |
| | 5.35 | 0.56 | 1 | 0 | 0.44 | 1.00 | 1 | 1.12 | 0.72 | 1.63 |
| 25° | — | 0.68 | 1 | 0 | 0.41 | 0.87 | 1 | 0.92 | 0.67 | 1.41 |
| 30° | — | 0.80 | 1 | 0 | 0.39 | 0.76 | 1 | 0.78 | 0.63 | 1.24 |
| 40° | — | 1.14 | 1 | 0 | 0.35 | 0.57 | 1 | 0.55 | 0.57 | 0.93 |

*For i, use 2 for DB, DF and 1 for DT

## Static Equivalent Load $P_o=X_oF_r+Y_oF_a$

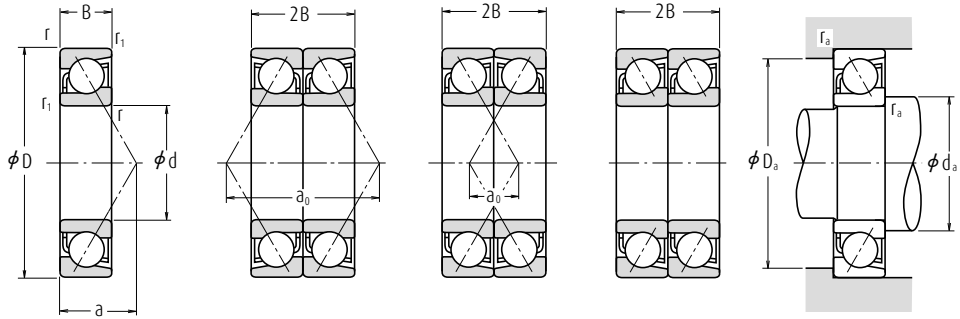
| Contact Angle | Single, DT | | DB or DF | |
|---|---|---|---|---|
| | $X_o$ | $Y_o$ | $X_o$ | $Y_o$ |
| 15° | 0.5 | 0.46 | 1 | 0.92 |
| 25° | 0.5 | 0.38 | 1 | 0.76 |
| 30° | 0.5 | 0.33 | 1 | 0.66 |
| 40° | 0.5 | 0.26 | 1 | 0.52 |

Single or DT mounting
When $F_r > 0.5F_r + Y_oF_a$ use $P_o=F_r$

| Bearing Numbers (2) Cage Symbol (4) | | | | | | Basic Load Ratings (Matched) (N) | | Limiting Speeds (1) (Matched) ($min^{-1}$) | | Load Center Spacings (mm) | | Abutment and Fillet Dimensions (mm) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | $a_0$ | | | | |
| Single | Standard | Option | Duplex | | | $C_r$ | $C_{0r}$ | Grease | Oil | DB | DF | $d_b$ (3) min. | $D_b$ max. | $r_b$ (3) max. |
| 7917 A5* | (M) | T,TYN | DB | DF | DT | 59 500 | 77 000 | 5 300 | 7 500 | 65.8 | 29.8 | — | 115 | 0.6 |
| 7917 C* | (M) | T, TYN | DB | DF | DT | 63 000 | 81 500 | 6 300 | 9 000 | 45.5 | 9.5 | — | 115 | 0.6 |
| 7017 A* | W | (M), T,TYN | DB | DF | DT | 91 500 | 112 000 | 4 300 | 5 600 | 84.1 | 40.1 | 90 | 125 | 0.6 |
| 7017 C* | (M) | W,T, TYN | DB | DF | DT | 98 000 | 117 000 | 6 000 | 8 500 | 50.8 | 6.8 | — | 125 | 0.6 |
| 7217 A* | W | (M), T,TYN | DB | DF | DT | 167 000 | 178 000 | 3 800 | 5 300 | 95.8 | 39.8 | 91 | 144 | 1 |
| 7217 B | W | (M), T | DB | DF | DT | 151 000 | 162 000 | 2 800 | 3 800 | 126.6 | 70.6 | 91 | 144 | 1 |
| 7217 C* | T85 | — | — | — | — | 174 000 | 181 000 | 5 600 | 7 500 | 59.5 | 3.5 | — | 144 | 1 |
| 7317 A | (M) | W,T,TYN | DB | DF | DT | 258 000 | 265 000 | 2 600 | 3 600 | 117.5 | 35.5 | 92 | 173 | 1 |
| 7317 B | W | (M), T | DB | DF | DT | 236 000 | 244 000 | 2 400 | 3 200 | 152.2 | 70.2 | 92 | 173 | 1 |
| 7918 A5* | W | (M), T | DB | DF | DT | 64 000 | 87 000 | 5 000 | 7 100 | 68.1 | 32.1 | — | 120 | 0.6 |
| 7918 C* | T85 | MR, T7 | — | — | — | 67 500 | 92 000 | 6 000 | 8 500 | 46.8 | 10.8 | — | 120 | 0.6 |
| 7018 A* | (M) | T,TYN | DB | DF | DT | 109 000 | 133 000 | 3 800 | 5 300 | 90.4 | 42.4 | 96 | 134 | 1 |
| 7018 C* | (M) | T, TYN | DB | DF | DT | 116 000 | 138 000 | 5 600 | 8 000 | 54.8 | 6.8 | — | 134 | 1 |
| 7218 A* | W | (M), T,TYN | DB | DF | DT | 191 000 | 206 000 | 3 600 | 5 000 | 102.2 | 42.2 | 96 | 154 | 1 |
| 7218 B | (M) | W,T, TYN | DB | DF | DT | 173 000 | 188 000 | 2 600 | 3 400 | 134.9 | 74.9 | 96 | 154 | 1 |
| 7218 C* | W | (M), T,TYN | DB | DF | DT | 199 000 | 209 000 | 5 300 | 7 100 | 63.5 | 3.5 | — | 154 | 1 |
| 7318 A | W | (M), T | DB | DF | DT | 277 000 | 294 000 | 2 600 | 3 400 | 123.8 | 37.8 | 97 | 183 | 1 |
| 7318 B | T85 | MR | — | — | — | 254 000 | 270 000 | 2 200 | 3 000 | 160.5 | 74.5 | 97 | 183 | 1 |
| 7919 A5* | (M) | W,T,TYN | DB | DF | DT | 64 500 | 91 000 | 4 800 | 6 700 | 70.5 | 34.5 | — | 125 | 0.6 |
| 7919 C* | W | (M), T | DB | DF | DT | 68 500 | 96 000 | 5 600 | 8 000 | 48.1 | 12.1 | — | 125 | 0.6 |
| 7019 A* | W | (M), T | DB | DF | DT | 109 000 | 134 000 | 3 800 | 5 000 | 93.3 | 45.3 | — | 139 | 1 |
| 7019 C* | T85 | MR | — | — | — | 119 000 | 146 000 | 5 300 | 7 500 | 56.1 | 8.1 | — | 139 | 1 |
| 7219 A* | (M) | T,TYN | DB | DF | DT | 208 000 | 221 000 | 3 400 | 4 500 | 108.5 | 44.5 | 102 | 163 | 1 |
| 7219 B | (M) | T, TYN | DB | DF | DT | 188 000 | 202 000 | 2 400 | 3 200 | 143.2 | 79.2 | 102 | 163 | 1 |
| 7219 C* | (M) | T,TYN | DB | DF | DT | 216 000 | 224 000 | 4 800 | 6 700 | 67.5 | 3.5 | — | 163 | 1 |
| 7319 A | (M) | T, TYN | DB | DF | DT | 297 000 | 325 000 | 2 400 | 3 200 | 130.2 | 40.2 | 102 | 193 | 1 |
| 7319 B | W | (M), T,TYN | DB | DF | DT | 272 000 | 298 000 | 2 200 | 3 000 | 168.7 | 78.7 | 102 | 193 | 1 |
| 7920 A5* | W | (M), T | DB | DF | DT | 77 000 | 103 000 | 4 500 | 6 300 | 76.0 | 36.0 | — | 135 | 0.6 |
| 7920 C* | T85 | MR, T7 | — | — | — | 81 500 | 108 000 | 5 300 | 7 500 | 52.2 | 12.2 | — | 135 | 0.6 |
| 7020 A* | (M) | W,T,TYN | DB | DF | DT | 111 000 | 141 000 | 3 600 | 5 000 | 96.2 | 48.2 | — | 144 | 1 |

**Note** (4) (M) in the column of cage symbols are usually omitted from the bearing number.

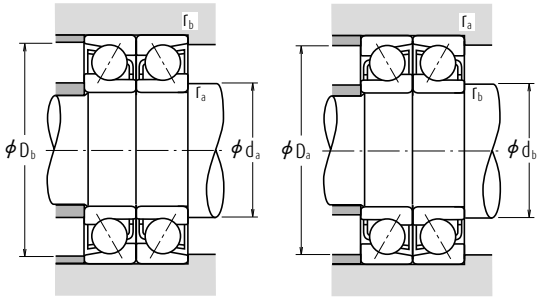
## Single/matched mountings
## Bore Diameter 100 – 120 mm




Single | Back-to-Back DB | Face-to-Face DF | Tandem DT

| Boundary Dimensions (mm) | | | | | Basic Load Ratings (Single) (N) | | Factor | Limiting Speeds (1) (min-1) | | Eff.Load Centers (mm) | Abutment and Fillet Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d | D | B | r min. | r1 min. | Cr | C0r | f0 | Grease | Oil | a | da min. | Da max. | ra max. | approx. |
| **100** | 150 | 24 | 1.5 | 1 | 79 000 | 77 000 | 16.0 | 9 200 | 14 000 | 28.7 | 109 | 141 | 1.5 | 1.46 |
| | 180 | 34 | 2.1 | 1.1 | 144 000 | 117 000 | — | 5 400 | 7 200 | 57.4 | 112 | 168 | 2 | 3.22 |
| | 180 | 34 | 2.1 | 1.1 | 130 000 | 114 000 | — | 2 800 | 3 800 | 75.7 | 112 | 168 | 2 | 3.28 |
| | 180 | 34 | 2.1 | 1.1 | 157 000 | 127 000 | 14.5 | 8 300 | 12 500 | 35.7 | 112 | 168 | 2 | 3.65 |
| | 215 | 47 | 3 | 1.1 | 207 000 | 193 000 | — | 2 800 | 3 800 | 69.0 | 114 | 201 | 2.5 | 7.29 |
| | 215 | 47 | 3 | 1.1 | 190 000 | 178 000 | — | 2 400 | 3 400 | 89.6 | 114 | 201 | 2.5 | 7.43 |
| **105** | 145 | 20 | 1.1 | 0.6 | 50 500 | 54 000 | — | 8 000 | 12 000 | 39.2 | 112 | 138 | 1 | 0.82 |
| | 145 | 20 | 1.1 | 0.6 | 53 500 | 57 000 | 16.6 | 9 200 | 14 000 | 26.7 | 112 | 138 | 1 | 0.826 |
| | 160 | 26 | 2 | 1 | 84 000 | 81 500 | — | 5 700 | 7 600 | 51.2 | 115 | 150 | 2 | 1.84 |
| | 160 | 26 | 2 | 1 | 92 500 | 89 500 | 15.9 | 8 700 | 13 300 | 30.7 | 115 | 150 | 2 | 1.82 |
| | 190 | 36 | 2.1 | 1.1 | 157 000 | 132 000 | — | 5 100 | 6 800 | 60.6 | 117 | 178 | 2 | 3.84 |
| | 190 | 36 | 2.1 | 1.1 | 142 000 | 129 000 | — | 2 600 | 3 600 | 79.9 | 117 | 178 | 2 | 3.92 |
| | 190 | 36 | 2.1 | 1.1 | 171 000 | 143 000 | 14.5 | 7 800 | 11 900 | 37.7 | 117 | 178 | 2 | 4.33 |
| | 225 | 49 | 3 | 1.1 | 208 000 | 56 000 | — | 2 600 | 3 600 | 72.1 | 119 | 211 | 2.5 | 9.34 |
| | 225 | 49 | 3 | 1.1 | 191 000 | 59 500 | — | 2 400 | 3 200 | 93.7 | 119 | 211 | 2.5 | 9.43 |
| **110** | 150 | 20 | 1.1 | 0.6 | 51 500 | 95 500 | — | 7 700 | 11 600 | 40.3 | 117 | 143 | 1 | 0.877 |
| | 150 | 20 | 1.1 | 0.6 | 54 500 | 104 000 | 16.7 | 8 900 | 13 500 | 27.4 | 117 | 143 | 1 | 0.867 |
| | 170 | 28 | 2 | 1 | 101 000 | 148 000 | — | 5 400 | 7 200 | 54.4 | 120 | 160 | 2 | 2.28 |
| | 170 | 28 | 2 | 1 | 111 000 | 144 000 | 15.6 | 8 300 | 12 500 | 32.7 | 120 | 160 | 2 | 2.26 |
| | 200 | 38 | 2.1 | 1.1 | 170 000 | 160 000 | — | 4 900 | 6 500 | 63.7 | 122 | 188 | 2 | 4.49 |
| | 200 | 38 | 2.1 | 1.1 | 154 000 | 144 000 | — | 2 600 | 3 400 | 84.0 | 122 | 188 | 2 | 4.58 |
| | 200 | 38 | 2.1 | 1.1 | 185 000 | 160 000 | 14.5 | 7 500 | 11 300 | 39.8 | 122 | 188 | 2 | 5.1 |
| | 240 | 50 | 3 | 1.1 | 220 000 | 215 000 | — | 2 600 | 3 400 | 75.5 | 124 | 226 | 2.5 | 11.1 |
| | 240 | 50 | 3 | 1.1 | 201 000 | 197 000 | — | 2 200 | 3 000 | 98.4 | 124 | 226 | 2.5 | 11.2 |
| **120** | 165 | 22 | 1.1 | 0.6 | 71 000 | 77 000 | — | 7 100 | 10 600 | 44.2 | 127 | 158 | 1 | 1.15 |
| | 165 | 22 | 1.1 | 0.6 | 75 500 | 81 000 | 16.5 | 8 100 | 12 300 | 30.1 | 127 | 158 | 1 | 1.15 |
| | 180 | 28 | 2 | 1 | 107 000 | 107 000 | — | 5 000 | 6 700 | 57.3 | 130 | 170 | 2 | 2.45 |
| | 215 | 40 | 2.1 | 1.1 | 192 000 | 177 000 | — | 4 500 | 6 000 | 68.3 | 132 | 203 | 2 | 6.22 |
| | 215 | 40 | 2.1 | 1.1 | 165 000 | 162 000 | — | 2 400 | 3 200 | 90.3 | 132 | 203 | 2 | 6.26 |
| | 260 | 55 | 3 | 1.1 | 246 000 | 252 000 | — | 2 200 | 3 000 | 82.3 | 134 | 246 | 2.5 | 14.5 |
| | 260 | 55 | 3 | 1.1 | 225 000 | 231 000 | — | 2 000 | 2 800 | 107.2 | 134 | 246 | 2.5 | 14.4 |

**Notes**
(1) For applications operating near the limiting speed, refer to Page **B079**.
(2) The suffixes A, A5, B, and C represent contact angles of 30°, 25°, 40°, and 15° respectively.
(3) For bearings marked — in the column for $d_b$, $d_b$ and $r_b$ for shafts are $d_a$ (min.) and $r_a$ (max.) respectively.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| Contact Angle | $if_oF_a^*/C_{or}$ | e | Single, DT | | | | DB or DF | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $F_a/F_r \le e$ | | $F_a/F_r > e$ | | $F_a/F_r \le e$ | | $F_a/F_r > e$ | |
| | | | X | Y | X | Y | X | Y | X | Y |
| 15° | 0.178 | 0.38 | 1 | 0 | 0.44 | 1.47 | 1 | 1.65 | 0.72 | 2.39 |
| | 0.357 | 0.40 | 1 | 0 | 0.44 | 1.40 | 1 | 1.57 | 0.72 | 2.28 |
| | 0.714 | 0.43 | 1 | 0 | 0.44 | 1.30 | 1 | 1.46 | 0.72 | 2.11 |
| | 1.07 | 0.46 | 1 | 0 | 0.44 | 1.23 | 1 | 1.38 | 0.72 | 2.00 |
| | 1.43 | 0.47 | 1 | 0 | 0.44 | 1.19 | 1 | 1.34 | 0.72 | 1.93 |
| | 2.14 | 0.50 | 1 | 0 | 0.44 | 1.12 | 1 | 1.26 | 0.72 | 1.82 |
| | 3.57 | 0.55 | 1 | 0 | 0.44 | 1.02 | 1 | 1.14 | 0.72 | 1.66 |
| | 5.35 | 0.56 | 1 | 0 | 0.44 | 1.00 | 1 | 1.12 | 0.72 | 1.63 |
| 25° | — | 0.68 | 1 | 0 | 0.41 | 0.87 | 1 | 0.92 | 0.67 | 1.41 |
| 30° | — | 0.80 | 1 | 0 | 0.39 | 0.76 | 1 | 0.78 | 0.63 | 1.24 |
| 40° | — | 1.14 | 1 | 0 | 0.35 | 0.57 | 1 | 0.55 | 0.57 | 0.93 |

*For i, use 2 for DB, DF and 1 for DT

## Static Equivalent Load $P_o=X_oF_r+Y_oF_a$

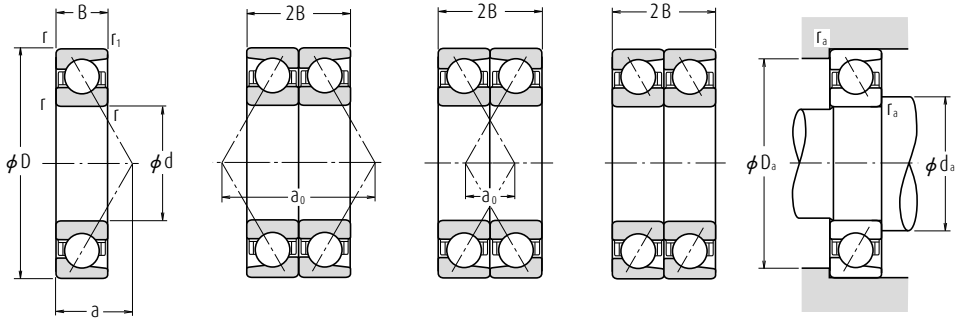
| Contact Angle | Single, DT | | DB or DF | |
|---|---|---|---|---|
| | $X_o$ | $Y_o$ | $X_o$ | $Y_o$ |
| 15° | 0.5 | 0.46 | 1 | 0.92 |
| 25° | 0.5 | 0.38 | 1 | 0.76 |
| 30° | 0.5 | 0.33 | 1 | 0.66 |
| 40° | 0.5 | 0.26 | 1 | 0.52 |

Single or DT mounting
When $F_r > 0.5F_r + Y_oF_a$
use $P_o = F_r$

| Bearing Numbers (2) Cage Symbol (4) | | | | | | Basic Load Ratings (Matched) (N) | | Limiting Speeds (1) (Matched) ($min^{-1}$) | | Load Center Spacings (mm) | | Abutment and Fillet Dimensions (mm) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | $a_0$ | | | | |
| Single | Standard | Option | Duplex | | | $C_r$ | $C_{0r}$ | Grease | Oil | DB | DF | $d_b$ (3) min. | $D_b$ max. | $r_b$ (3) max. |
| 7020 C* | (M) | T, TYN | DB | DF | DT | 122 000 | 154 000 | 5 300 | 7 100 | 57.5 | 9.5 | — | 144 | 1 |
| 7220 A* | W | (M), T,TYN | DB | DF | DT | 233 000 | 251 000 | 3 200 | 4 300 | 114.8 | 46.8 | 107 | 173 | 1 |
| 7220 B | W | (M), T | DB | DF | DT | 212 000 | 229 000 | 2 200 | 3 000 | 151.5 | 83.5 | 107 | 173 | 1 |
| 7220 C* | T85 | MR | — | — | — | 242 000 | 254 000 | 4 500 | 6 300 | 71.5 | 3.5 | — | 173 | 1 |
| 7320 A | (M) | W,T,TYN | DB | DF | DT | 335 000 | 385 000 | 2 200 | 3 000 | 137.9 | 43.9 | 107 | 208 | 1 |
| 7320 B | W | (M), T | DB | DF | DT | 310 000 | 355 000 | 2 000 | 2 800 | 179.2 | 85.2 | 107 | 208 | 1 |
| 7921 A5* | W | (M), T | DB | DF | DT | 78 500 | 108 000 | 4 300 | 6 000 | 78.3 | 38.3 | — | 140 | 0.6 |
| 7921 C* | T85 | MR, T7 | — | — | — | 83 000 | 114 000 | 5 300 | 7 100 | 53.5 | 13.5 | — | 140 | 0.6 |
| 7021 A* | (M) | T,TYN | DB | DF | DT | 130 000 | 163 000 | 3 400 | 4 500 | 102.5 | 50.5 | — | 154 | 1 |
| 7021 C* | (M) | T, TYN | DB | DF | DT | 143 000 | 179 000 | 4 800 | 6 700 | 61.5 | 9.5 | — | 154 | 1 |
| 7221 A* | (M) | T,TYN | DB | DF | DT | 254 000 | 283 000 | 3 000 | 4 000 | 121.2 | 49.2 | 112 | 183 | 1 |
| 7221 B | (M) | T, TYN | DB | DF | DT | 231 000 | 258 000 | 2 200 | 3 000 | 159.8 | 87.8 | 112 | 183 | 1 |
| 7221 C* | W | (M), T | DB | DF | DT | 264 000 | 286 000 | 4 300 | 6 000 | 75.5 | 3.5 | — | 183 | 1 |
| 7321 A | W | (M), T | DB | DF | DT | 335 000 | 385 000 | 2 200 | 2 800 | 144.3 | 46.3 | — | 218 | 1 |
| 7321 B | T85 | — | — | — | — | 310 000 | 355 000 | 1 900 | 2 600 | 187.4 | 89.4 | — | 218 | 1 |
| 7922 A5* | (M) | W,T,TYN | DB | DF | DT | 79 500 | 112 000 | 4 300 | 5 600 | 80.6 | 40.6 | — | 145 | 0.6 |
| 7922 C* | (M) | T | DB | DF | DT | 84 500 | 119 000 | 5 000 | 6 700 | 54.8 | 14.8 | — | 145 | 0.6 |
| 7022 A* | (M) | T | DB | DF | DT | 157 000 | 191 000 | 3 200 | 4 300 | 108.8 | 52.8 | — | 164 | 1 |
| 7022 C* | T85 | T7 | — | — | — | 172 000 | 208 000 | 4 500 | 6 300 | 65.5 | 9.5 | — | 164 | 1 |
| 7222 A* | (M) | T,TYN | DB | DF | DT | 276 000 | 315 000 | 2 800 | 4 000 | 127.5 | 51.5 | 117 | 193 | 1 |
| 7222 B | (M) | T, TYN | DB | DF | DT | 250 000 | 289 000 | 2 000 | 2 800 | 168.1 | 92.1 | 117 | 193 | 1 |
| 7222 C* | (M) | T,TYN | DB | DF | DT | 286 000 | 320 000 | 4 000 | 5 600 | 79.5 | 3.5 | — | 193 | 1 |
| 7322 A | (M) | T, TYN | DB | DF | DT | 360 000 | 430 000 | 2 000 | 2 600 | 151.0 | 51.0 | — | 233 | 1 |
| 7322 B | W | (M), T,TYN | DB | DF | DT | 325 000 | 395 000 | 1 800 | 2 400 | 196.8 | 96.8 | — | 233 | 1 |
| 7924 A5* | W | (M), T | DB | DF | DT | 110 000 | 154 000 | 3 800 | 5 300 | 88.5 | 44.5 | — | 160 | 0.6 |
| 7924 C* | T85 | MR | — | — | — | 117 000 | 162 000 | 4 500 | 6 300 | 60.2 | 16.2 | — | 160 | 0.6 |
| 7024 A* | (M) | W,T,TYN | DB | DF | DT | 166 000 | 213 000 | 3 000 | 4 000 | 114.6 | 58.6 | — | 174 | 1 |
| 7224 A* | (M) | W,T | DB | DF | DT | 297 000 | 355 000 | 2 600 | 3 600 | 136.7 | 56.7 | — | 208 | 1 |
| 7224 B | (M) | W,T | DB | DF | DT | 269 000 | 325 000 | 1 900 | 2 600 | 180.5 | 100.5 | — | 208 | 1 |
| 7324 A | T85 | MR | — | — | — | 400 000 | 505 000 | 1 800 | 2 400 | 164.7 | 54.7 | — | 253 | 1 |
| 7324 B | (M) | T,TYN | DB | DF | DT | 365 000 | 460 000 | 1 600 | 2 200 | 214.4 | 104.4 | — | 253 | 1 |

**Note** (4) (M) in the column of cage symbols are usually omitted from the bearing number.

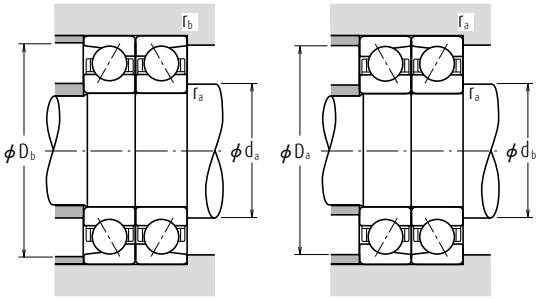
## Single/matched mountings
## Bore Diameter 130 – 170 mm




Single | Back-to-Back DB | Face-to-Face DF | Tandem DT

| Boundary Dimensions (mm) | | | | | Basic Load Ratings (Single) (N) | | Factor | Limiting Speeds (1) (min-1) | | Eff.Load Centers (mm) | Abutment and Fillet Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d | D | B | r min. | r1 min. | Cr | C0r | f0 | Grease | Oil | a | da min. | Da max. | ra max. | approx. |
| **130** | 180 | 24 | 1.5 | 1 | 78 000 | 86 000 | — | 6 500 | 9 700 | 48.1 | 139 | 171 | 1.5 | 1.54 |
| | 180 | 24 | 1.5 | 1 | 82 500 | 91 000 | 16.5 | 7 500 | 11 300 | 32.8 | 139 | 171 | 1.5 | 1.5 |
| | 200 | 33 | 2 | 1 | 123 000 | 125 000 | — | 4 600 | 6 100 | 64.1 | 140 | 190 | 2 | 3.68 |
| | 230 | 40 | 3 | 1.1 | 199 000 | 193 000 | — | 4 200 | 5 600 | 72.0 | 144 | 216 | 2.5 | 7.06 |
| | 230 | 40 | 3 | 1.1 | 171 000 | 175 000 | — | 2 200 | 3 000 | 95.5 | 144 | 216 | 2.5 | 7.1 |
| | 280 | 58 | 4 | 1.5 | 273 000 | 293 000 | — | 2 200 | 2 800 | 88.2 | 148 | 262 | 3 | 17.5 |
| | 280 | 58 | 4 | 1.5 | 250 000 | 268 000 | — | 1 900 | 2 600 | 115.0 | 148 | 262 | 3 | 17.6 |
| **140** | 190 | 24 | 1.5 | 1 | 78 500 | 90 000 | — | 6 100 | 9 100 | 50.5 | 149 | 181 | 1.5 | 1.63 |
| | 190 | 24 | 1.5 | 1 | 83 500 | 95 500 | 16.7 | 7 000 | 10 700 | 34.1 | 149 | 181 | 1.5 | 1.63 |
| | 210 | 33 | 2 | 1 | 126 000 | 133 000 | — | 4 300 | 5 800 | 67.0 | 150 | 200 | 2 | 3.9 |
| | 250 | 42 | 3 | 1.1 | 229 000 | 234 000 | — | 3 900 | 5 200 | 77.3 | 154 | 236 | 2.5 | 8.92 |
| | 250 | 42 | 3 | 1.1 | 197 000 | 213 000 | — | 2 000 | 2 800 | 102.8 | 154 | 236 | 2.5 | 8.94 |
| | 300 | 62 | 4 | 1.5 | 300 000 | 335 000 | — | 2 000 | 2 600 | 94.5 | 158 | 282 | 3 | 21.4 |
| | 300 | 62 | 4 | 1.5 | 275 000 | 310 000 | — | 1 700 | 2 400 | 123.3 | 158 | 282 | 3 | 21.6 |
| **150** | 210 | 28 | 2 | 1 | 101 000 | 115 000 | — | 5 600 | 8 400 | 56.0 | 160 | 200 | 2 | 2.97 |
| | 210 | 28 | 2 | 1 | 107 000 | 122 000 | 16.6 | 6 400 | 9 800 | 38.1 | 160 | 200 | 2 | 2.96 |
| | 225 | 35 | 2.1 | 1.1 | 144 000 | 154 000 | — | 4 000 | 5 400 | 71.6 | 162 | 213 | 2 | 4.75 |
| | 270 | 45 | 3 | 1.1 | 261 000 | 280 000 | — | 3 600 | 4 800 | 83.1 | 164 | 256 | 2.5 | 11.2 |
| | 270 | 45 | 3 | 1.1 | 225 000 | 254 000 | — | 1 800 | 2 600 | 110.6 | 164 | 256 | 2.5 | 11.2 |
| | 320 | 65 | 4 | 1.5 | 315 000 | 370 000 | — | 1 800 | 2 400 | 100.3 | 168 | 302 | 3 | 26 |
| | 320 | 65 | 4 | 1.5 | 289 000 | 340 000 | — | 1 600 | 2 200 | 131.1 | 168 | 302 | 3 | 25.9 |
| **160** | 220 | 28 | 2 | 1 | 112 000 | 133 000 | 16.7 | 3 600 | 4 800 | 39.4 | 170 | 210 | 2 | 3.1 |
| | 240 | 38 | 2.1 | 1.1 | 163 000 | 176 000 | — | 3 300 | 4 500 | 76.7 | 172 | 228 | 2 | 5.77 |
| | 290 | 48 | 3 | 1.1 | 263 000 | 305 000 | — | 1 900 | 2 600 | 89.0 | 174 | 276 | 2.5 | 14.1 |
| | 290 | 48 | 3 | 1.1 | 238 000 | 279 000 | — | 1 700 | 2 400 | 118.4 | 174 | 276 | 2.5 | 14.2 |
| | 340 | 68 | 4 | 1.5 | 345 000 | 420 000 | — | 1 700 | 2 200 | 106.2 | 178 | 322 | 3 | 30.7 |
| | 340 | 68 | 4 | 1.5 | 315 000 | 385 000 | — | 1 500 | 2 000 | 138.9 | 178 | 322 | 3 | 30.8 |
| **170** | 230 | 28 | 2 | 1 | 118 000 | 148 000 | 16.8 | 5 300 | 8 300 | 40.8 | 180 | 220 | 2 | 3.36 |
| | 260 | 42 | 2.1 | 1.1 | 195 000 | 214 000 | — | 3 100 | 4 200 | 83.1 | 182 | 248 | 2 | 7.9 |
| | 310 | 52 | 4 | 1.5 | 295 000 | 360 000 | — | 1 800 | 2 400 | 95.3 | 188 | 292 | 3 | 17.3 |
| | 310 | 52 | 4 | 1.5 | 266 000 | 325 000 | — | 1 600 | 2 200 | 126.7 | 188 | 292 | 3 | 17.6 |
| | 360 | 72 | 4 | 1.5 | 390 000 | 485 000 | — | 1 600 | 2 200 | 112.5 | 188 | 342 | 3 | 35.8 |
| | 360 | 72 | 4 | 1.5 | 355 000 | 445 000 | — | 1 400 | 2 000 | 147.2 | 188 | 342 | 3 | 35.6 |

**Notes**
(1) For applications operating near the limiting speed, refer to Page **B079**.
(2) The suffixes A, A5, B, and C represent contact angles of 30°, 25°, 40°, and 15° respectively.
(3) For bearings marked — in the column for $d_b$, $d_b$ and $r_b$ for shafts are $d_a$ (min.) and $r_a$ (max.) respectively.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| Contact Angle | $if_oF_a/C_{0r}$ | e | Single, DT | | | | DB or DF | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $F_a/F_r \le e$ | | $F_a/F_r > e$ | | $F_a/F_r \le e$ | | $F_a/F_r > e$ | |
| | | | X | Y | X | Y | X | Y | X | Y |
| 15° | 0.178 | 0.38 | 1 | 0 | 0.44 | 1.47 | 1 | 1.65 | 0.72 | 2.39 |
| | 0.357 | 0.40 | 1 | 0 | 0.44 | 1.40 | 1 | 1.57 | 0.72 | 2.28 |
| | 0.714 | 0.43 | 1 | 0 | 0.44 | 1.30 | 1 | 1.46 | 0.72 | 2.11 |
| | 1.07 | 0.46 | 1 | 0 | 0.44 | 1.23 | 1 | 1.38 | 0.72 | 2.00 |
| | 1.43 | 0.47 | 1 | 0 | 0.44 | 1.19 | 1 | 1.34 | 0.72 | 1.93 |
| | 2.14 | 0.50 | 1 | 0 | 0.44 | 1.12 | 1 | 1.26 | 0.72 | 1.82 |
| | 3.57 | 0.55 | 1 | 0 | 0.44 | 1.02 | 1 | 1.14 | 0.72 | 1.66 |
| | 5.35 | 0.56 | 1 | 0 | 0.44 | 1.00 | 1 | 1.12 | 0.72 | 1.63 |
| 25° | — | 0.68 | 1 | 0 | 0.41 | 0.87 | 1 | 0.92 | 0.67 | 1.41 |
| 30° | — | 0.80 | 1 | 0 | 0.39 | 0.76 | 1 | 0.78 | 0.63 | 1.24 |
| 40° | — | 1.14 | 1 | 0 | 0.35 | 0.57 | 1 | 0.55 | 0.57 | 0.93 |

*For i, use 2 for DB, DF and 1 for DT

## Static Equivalent Load $P_o=X_oF_r+Y_oF_a$

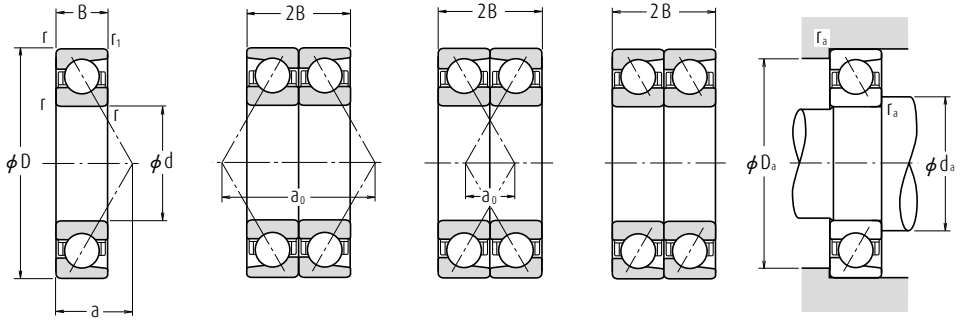
| Contact Angle | Single, DT | | DB or DF | |
|---|---|---|---|---|
| | $X_o$ | $Y_o$ | $X_o$ | $Y_o$ |
| 15° | 0.5 | 0.46 | 1 | 0.92 |
| 25° | 0.5 | 0.38 | 1 | 0.76 |
| 30° | 0.5 | 0.33 | 1 | 0.66 |
| 40° | 0.5 | 0.26 | 1 | 0.52 |

Single or DT mounting
When $F_r>0.5F_r+Y_oF_a$ use $P_o=F_r$

| Bearing Numbers (2) Cage Symbol (4) | | | | | | Basic Load Ratings (Matched) (N) | | Limiting Speeds (1) (Matched) ($min^{-1}$) | | Load Center Spacings (mm) $a_0$ | | Abutment and Fillet Dimensions (mm) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Single | Standard | Option | Duplex | | | $C_r$ | $C_{0r}$ | Grease | Oil | DB | DF | $d_b$ (3) min. | $D_b$ max. | $r_b$ (3) max. |
| 7926 A5* | (M) | T,TYN | DB | DF | DT | 120 000 | 172 000 | 3 400 | 4 800 | 96.3 | 48.3 | — | 174 | 1 |
| 7926 C* | (M) | T, TYN | DB | DF | DT | 128 000 | 182 000 | 4 000 | 5 600 | 65.5 | 17.5 | — | 174 | 1 |
| 7026 A* | (M) | T,TYN | DB | DF | DT | 191 000 | 251 000 | 2 600 | 3 600 | 128.3 | 62.3 | — | 194 | 1 |
| 7226 A* | (M) | T | DB | DF | DT | 310 000 | 385 000 | 1 900 | 2 600 | 143.9 | 63.9 | — | 223 | 1 |
| 7226 B | (M) | T | DB | DF | DT | 278 000 | 350 000 | 1 700 | 2 400 | 191.0 | 111.0 | — | 223 | 1 |
| 7326 A | (M) | T | DB | DF | DT | 445 000 | 585 000 | 1 700 | 2 200 | 176.3 | 60.3 | — | 271 | 1.5 |
| 7326 B | (M) | T | DB | DF | DT | 405 000 | 535 000 | 1 500 | 2 000 | 230.0 | 114.0 | — | 271 | 1.5 |
| 7928 A5* | (M) | T,TYN | DB | DF | DT | 122 000 | 180 000 | 3 200 | 4 500 | 100.9 | 52.9 | — | 184 | 1 |
| 7928 C* | (M) | T, TYN | DB | DF | DT | 129 000 | 191 000 | 3 800 | 5 300 | 68.2 | 20.2 | — | 184 | 1 |
| 7028 A* | (M) | T | DB | DF | DT | 194 000 | 265 000 | 2 600 | 3 400 | 134.0 | 68.0 | — | 204 | 1 |
| 7228 A* | (M) | T | DB | DF | DT | 355 000 | 470 000 | 1 800 | 2 400 | 154.6 | 70.6 | — | 243 | 1 |
| 7228 B | (M) | T | DB | DF | DT | 320 000 | 425 000 | 1 600 | 2 200 | 205.6 | 121.6 | — | 243 | 1 |
| 7328 A | (M) | T | DB | DF | DT | 490 000 | 670 000 | 1 600 | 2 000 | 189.0 | 65.0 | — | 291 | 1.5 |
| 7328 B | (M) | T | DB | DF | DT | 445 000 | 615 000 | 1 400 | 1 900 | 246.6 | 122.6 | — | 291 | 1.5 |
| 7930 A5* | (M) | — | DB | DF | DT | 157 000 | 231 000 | 3 000 | 4 000 | 112.0 | 56.0 | — | 204 | 1 |
| 7930 C* | (M) | — | DB | DF | DT | 166 000 | 244 000 | 3 600 | 4 800 | 76.2 | 20.2 | — | 204 | 1 |
| 7030 A* | (M) | T | DB | DF | DT | 222 000 | 305 000 | 1 900 | 2 400 | 143.3 | 73.3 | — | 218 | 1 |
| 7230 A* | (M) | — | DB | DF | DT | 405 000 | 560 000 | 1 600 | 2 200 | 166.3 | 76.3 | — | 263 | 1 |
| 7230 B | (M) | T | DB | DF | DT | 365 000 | 510 000 | 1 500 | 2 000 | 221.2 | 131.2 | — | 263 | 1 |
| 7330 A | (M) | — | DB | DF | DT | 515 000 | 745 000 | 1 500 | 1 900 | 200.7 | 70.7 | — | 311 | 1.5 |
| 7330 B | (M) | T | DB | DF | DT | 470 000 | 680 000 | 1 300 | 1 800 | 262.2 | 132.2 | — | 311 | 1.5 |
| 7932 C* | (M) | TYN | DB | DF | DT | 173 000 | 265 000 | 3 000 | 4 000 | 78.9 | 22.9 | — | 214 | 1 |
| 7032 A* | (M) | T | DB | DF | DT | 252 000 | 355 000 | 1 700 | 2 400 | 153.5 | 77.5 | — | 233 | 1 |
| 7232 A | (M) | T | DB | DF | DT | 425 000 | 615 000 | 1 500 | 2 000 | 177.9 | 81.9 | — | 283 | 1 |
| 7232 B | (M) | — | DB | DF | DT | 385 000 | 555 000 | 1 400 | 1 900 | 236.8 | 140.8 | — | 283 | 1 |
| 7332 A | (M) | T | DB | DF | DT | 565 000 | 845 000 | 1 400 | 1 800 | 212.3 | 76.3 | — | 331 | 1.5 |
| 7332 B | (M) | T | DB | DF | DT | 515 000 | 770 000 | 1 200 | 1 700 | 277.8 | 141.8 | — | 331 | 1.5 |
| 7934 C* | (M) | — | DB | DF | DT | 183 000 | 297 000 | 2 800 | 3 800 | 81.6 | 25.6 | — | 224 | 1 |
| 7034 A* | (M) | — | DB | DF | DT | 300 000 | 430 000 | 1 600 | 2 200 | 166.1 | 82.1 | — | 253 | 1 |
| 7234 A | (M) | — | DB | DF | DT | 480 000 | 715 000 | 1 400 | 1 900 | 190.6 | 86.6 | — | 301 | 1.5 |
| 7234 B | (M) | — | DB | DF | DT | 435 000 | 650 000 | 1 300 | 1 700 | 253.4 | 149.4 | — | 301 | 1.5 |
| 7334 A | (M) | — | DB | DF | DT | 630 000 | 970 000 | 1 300 | 1 700 | 225.0 | 81.0 | — | 351 | 1.5 |
| 7334 B | (M) | T | DB | DF | DT | 575 000 | 890 000 | 1 100 | 1 600 | 294.3 | 150.3 | — | 351 | 1.5 |

**Note** (4) (M) in the column of cage symbols are usually omitted from the bearing number.

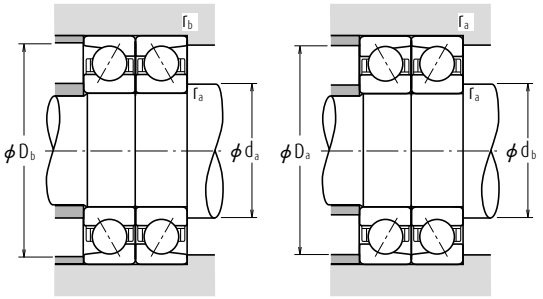
## Single/matched mountings
## Bore Diameter 180 – 200 mm




Single | Back-to-Back DB | Face-to-Face DF | Tandem DT

| Boundary Dimensions (mm) | | | | | Basic Load Ratings (Single) (N) | | Factor | Limiting Speeds (1) (min-1) | | Eff.Load Centers (mm) | Abutment and Fillet Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d | D | B | r min. | r1 min. | Cr | C0r | f0 | Grease | Oil | a | da min. | Da max. | ra max. | approx. |
| **180** | 250 | 33 | 2 | 1 | 152 000 | 184 000 | 16.6 | 4 900 | 7 700 | 45.3 | 190 | 240 | 2 | 4.9 |
| | 280 | 46 | 2.1 | 1.1 | 218 000 | 252 000 | — | 2 900 | 4 000 | 89.4 | 192 | 268 | 2 | 10.5 |
| | 320 | 52 | 4 | 1.5 | 305 000 | 385 000 | — | 1 700 | 2 200 | 98.2 | 198 | 302 | 3 | 18.1 |
| | 320 | 52 | 4 | 1.5 | 276 000 | 350 000 | — | 1 500 | 2 000 | 130.9 | 198 | 302 | 3 | 18.4 |
| | 380 | 75 | 4 | 1.5 | 410 000 | 535 000 | — | 1 500 | 2 000 | 118.3 | 198 | 362 | 3 | 42.1 |
| | 380 | 75 | 4 | 1.5 | 375 000 | 490 000 | — | 1 300 | 1 800 | 155.0 | 198 | 362 | 3 | 42.6 |
| **190** | 260 | 33 | 2 | 1 | 155 000 | 192 000 | 16.7 | 4 700 | 7 400 | 46.6 | 200 | 250 | 2 | 4.98 |
| | 290 | 46 | 2.1 | 1.1 | 235 000 | 280 000 | — | 2 800 | 3 800 | 92.3 | 202 | 278 | 2 | 11.3 |
| | 340 | 55 | 4 | 1.5 | 315 000 | 410 000 | — | 1 600 | 2 200 | 104.0 | 208 | 322 | 3 | 22.4 |
| | 340 | 55 | 4 | 1.5 | 284 000 | 375 000 | — | 1 400 | 2 000 | 138.7 | 208 | 322 | 3 | 22.5 |
| | 400 | 78 | 5 | 2 | 450 000 | 600 000 | — | 1 400 | 1 900 | 124.2 | 212 | 378 | 4 | 47.5 |
| | 400 | 78 | 5 | 2 | 410 000 | 550 000 | — | 1 300 | 1 700 | 162.8 | 212 | 378 | 4 | 47.2 |
| **200** | 280 | 38 | 2.1 | 1.1 | 199 000 | 244 000 | 16.5 | 4 400 | 6 900 | 51.2 | 212 | 268 | 2 | 6.85 |
| | 310 | 51 | 2.1 | 1.1 | 252 000 | 310 000 | — | 2 600 | 3 600 | 99.1 | 212 | 298 | 2 | 13.7 |
| | 360 | 58 | 4 | 1.5 | 335 000 | 450 000 | — | 1 500 | 2 000 | 109.8 | 218 | 342 | 3 | 26.5 |
| | 360 | 58 | 4 | 1.5 | 305 000 | 410 000 | — | 1 300 | 1 800 | 146.5 | 218 | 342 | 3 | 26.6 |
| | 420 | 80 | 5 | 2 | 475 000 | 660 000 | — | 1 300 | 1 800 | 129.5 | 222 | 398 | 4 | 54.4 |
| | 420 | 80 | 5 | 2 | 430 000 | 600 000 | — | 1 200 | 1 600 | 170.1 | 222 | 398 | 4 | 55.3 |

**Notes**
(1) For applications operating near the limiting speed, refer to Page **B079**.
(2) The suffixes A, A5, B, and C represent contact angles of 30°, 25°, 40°, and 15° respectively.
(3) For bearings marked — in the column for $d_b$, $d_b$ and $r_b$ for shafts are $d_a$ (min.) and $r_a$ (max.) respectively.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| Contact Angle | $if_oF_a/C_{or}$ | e | Single, DT | | | | DB or DF | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $F_a/F_r \le e$ | | $F_a/F_r > e$ | | $F_a/F_r \le e$ | | $F_a/F_r > e$ | |
| | | | X | Y | X | Y | X | Y | X | Y |
| 15° | 0.178 | 0.38 | 1 | 0 | 0.44 | 1.47 | 1 | 1.65 | 0.72 | 2.39 |
| | 0.357 | 0.40 | 1 | 0 | 0.44 | 1.40 | 1 | 1.57 | 0.72 | 2.28 |
| | 0.714 | 0.43 | 1 | 0 | 0.44 | 1.30 | 1 | 1.46 | 0.72 | 2.11 |
| | 1.07 | 0.46 | 1 | 0 | 0.44 | 1.23 | 1 | 1.38 | 0.72 | 2.00 |
| | 1.43 | 0.47 | 1 | 0 | 0.44 | 1.19 | 1 | 1.34 | 0.72 | 1.93 |
| | 2.14 | 0.50 | 1 | 0 | 0.44 | 1.12 | 1 | 1.26 | 0.72 | 1.82 |
| | 3.57 | 0.55 | 1 | 0 | 0.44 | 1.02 | 1 | 1.14 | 0.72 | 1.66 |
| | 5.35 | 0.56 | 1 | 0 | 0.44 | 1.00 | 1 | 1.12 | 0.72 | 1.63 |
| 25° | — | 0.68 | 1 | 0 | 0.41 | 0.87 | 1 | 0.92 | 0.67 | 1.41 |
| 30° | — | 0.80 | 1 | 0 | 0.39 | 0.76 | 1 | 0.78 | 0.63 | 1.24 |
| 40° | — | 1.14 | 1 | 0 | 0.35 | 0.57 | 1 | 0.55 | 0.57 | 0.93 |

*For i, use 2 for DB, DF and 1 for DT

## Static Equivalent Load $P_o=X_oF_r+Y_oF_a$

| Contact Angle | Single, DT | | DB or DF | |
|---|---|---|---|---|
| | $X_o$ | $Y_o$ | $X_o$ | $Y_o$ |
| 15° | 0.5 | 0.46 | 1 | 0.92 |
| 25° | 0.5 | 0.38 | 1 | 0.76 |
| 30° | 0.5 | 0.33 | 1 | 0.66 |
| 40° | 0.5 | 0.26 | 1 | 0.52 |

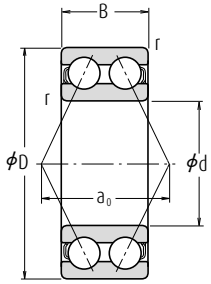
Single or DT mounting
When $F_r > 0.5F_r + Y_oF_a$ use $P_o = F_r$

| Bearing Numbers (2) Cage Symbol (4) | | | | Basic Load Ratings (Matched) (N) | | Limiting Speeds (1) (Matched) ($min^{-1}$) | | Load Center Spacings (mm) | | Abutment and Fillet Dimensions (mm) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | $a_0$ | | | | |
| Single | Standard | Option | Duplex | $C_r$ | $C_{0r}$ | Grease | Oil | DB | DF | $d_b$ (3) min. | $D_b$ max. | $r_b$ (3) max. |
| 7936 C* | (M) | — | DB DF DT | 236 000 | 370 000 | 2 600 | 3 600 | 90.6 | 24.6 | — | 244 | 1 |
| 7036 A* | (M) | — | DB DF DT | 335 000 | 505 000 | 1 500 | 2 000 | 178.8 | 86.8 | — | 273 | 1 |
| 7236 A | (M) | — | DB DF DT | 495 000 | 770 000 | 1 400 | 1 800 | 196.3 | 92.3 | — | 311 | 1.5 |
| 7236 B | (M) | — | DB DF DT | 450 000 | 700 000 | 1 200 | 1 700 | 261.8 | 157.8 | — | 311 | 1.5 |
| 7336 A | (M) | — | DB DF DT | 665 000 | 1 070 000 | 1 200 | 1 600 | 236.6 | 86.6 | — | 371 | 1.5 |
| 7336 B | (M) | — | DB DF DT | 605 000 | 975 000 | 1 100 | 1 500 | 309.9 | 159.9 | — | 371 | 1.5 |
| 7938 C* | (M) | TYN | DB DF DT | 239 000 | 385 000 | 2 400 | 3 400 | 93.3 | 27.3 | — | 254 | 1 |
| 7038 A* | (M) | — | DB DF DT | 365 000 | 560 000 | 1 400 | 1 900 | 184.6 | 92.6 | — | 283 | 1 |
| 7238 A | (M) | — | DB DF DT | 510 000 | 825 000 | 1 300 | 1 700 | 208.0 | 98.0 | — | 331 | 1.5 |
| 7238 B | (M) | — | DB DF DT | 460 000 | 750 000 | 1 100 | 1 600 | 277.3 | 167.3 | — | 331 | 1.5 |
| 7338 A | (M) | T | DB DF DT | 730 000 | 1 200 000 | 1 100 | 1 500 | 248.3 | 92.3 | — | 390 | 2 |
| 7338 B | (M) | — | DB DF DT | 670 000 | 1 100 000 | 1 000 | 1 400 | 325.5 | 169.5 | — | 390 | 2 |
| 7940 C* | (M) | — | DB DF DT | 305 000 | 490 000 | 2 200 | 3 200 | 102.3 | 26.3 | — | 273 | 1 |
| 7040 A* | (M) | T | DB DF DT | 390 000 | 620 000 | 1 300 | 1 800 | 198.2 | 96.2 | — | 303 | 1 |
| 7240 A | (M) | — | DB DF DT | 550 000 | 900 000 | 1 200 | 1 600 | 219.6 | 103.6 | — | 351 | 1.5 |
| 7240 B | (M) | — | DB DF DT | 495 000 | 815 000 | 1 100 | 1 500 | 292.9 | 176.9 | — | 351 | 1.5 |
| 7340 A | (M) | T | DB DF DT | 770 000 | 1 320 000 | 1 100 | 1 400 | 259.0 | 99.0 | — | 410 | 2 |
| 7340 B | (M) | — | DB DF DT | 700 000 | 1 200 000 | 950 | 1 300 | 340.1 | 180.1 | — | 410 | 2 |

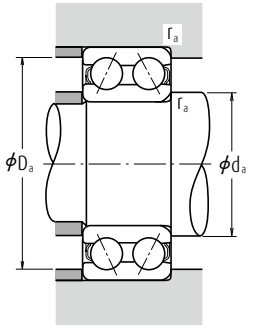
**Note** (4) (M) in the column of cage symbols are usually omitted from the bearing number.

# Double-Row Angular Contact Ball Bearings

## Bore Diameter 10 – 85 mm




| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Limiting Speeds ($min^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Grease | | Oil |
| d | D | B | r min. | $C_r$ | $C_{0r}$ | Open ZZ | DDU | Open |
| 10 | 30 | 14,3 | 0,6 | 7 150 | 3 900 | 17 000 | – | 22 000 |
| | 30 | 14,3 | 0,6 | 7 150 | 3 900 | 17 000 | 15 000 | – |
| 12 | 32 | 15,9 | 0,6 | 10 500 | 5 800 | 15 000 | – | 20 000 |
| | 32 | 15,9 | 0,6 | 8 500 | 5 300 | 15 000 | 12 000 | – |
| 15 | 35 | 15,9 | 0,6 | 11 700 | 7 050 | 13 000 | – | 17 000 |
| | 35 | 15,9 | 0,6 | 8 500 | 5 300 | 13 000 | 12 000 | – |
| | 42 | 19 | 1 | 17 600 | 10 200 | 11 000 | – | 15 000 |
| | 42 | 19 | 1 | 14 700 | 9 100 | 11 000 | 10 000 | – |
| 17 | 40 | 17,5 | 0,6 | 14 600 | 9 050 | 11 000 | – | 15 000 |
| | 40 | 17,5 | 0,6 | 12 700 | 8 300 | 11 000 | 10 000 | – |
| | 47 | 22,2 | 1 | 21 000 | 12 600 | 10 000 | – | 13 000 |
| | 47 | 22,2 | 1 | 19 600 | 12 400 | 10 000 | 9 500 | – |
| 20 | 47 | 20,6 | 1 | 19 600 | 12 400 | 10 000 | – | 13 000 |
| | 47 | 20,6 | 1 | 15 900 | 10 700 | 10 000 | 9 000 | – |
| | 52 | 22,2 | 1,1 | 24 600 | 15 000 | 9 000 | – | 12 000 |
| | 52 | 22,2 | 1,1 | 19 700 | 12 800 | 9 000 | 8 500 | – |
| 25 | 52 | 20,6 | 1 | 21 300 | 14 700 | 8 500 | – | 11 000 |
| | 52 | 20,6 | 1 | 16 900 | 12 300 | 8 500 | 7 500 | – |
| | 62 | 25,4 | 1,1 | 32 500 | 20 700 | 7 500 | – | 10 000 |
| | 62 | 25,4 | 1,1 | 25 200 | 18 200 | 7 500 | 6 300 | – |
| 30 | 62 | 23,8 | 1 | 29 600 | 21 100 | 7 100 | – | 9 500 |
| | 62 | 23,8 | 1 | 25 200 | 18 200 | 7 100 | 6 300 | – |
| | 72 | 30,2 | 1,1 | 40 500 | 28 100 | 6 300 | – | 8 500 |
| | 72 | 30,2 | 1,1 | 39 000 | 28 700 | 6 300 | 5 300 | – |
| 35 | 72 | 27 | 1,1 | 39 000 | 28 700 | 6 300 | – | 8 000 |
| | 72 | 27 | 1,1 | 34 000 | 25 300 | 6 300 | 5 300 | – |
| | 80 | 34,9 | 1,5 | 51 000 | 36 000 | 5 600 | – | 7 500 |
| | 80 | 34,9 | 1,5 | 44 000 | 33 500 | 5 600 | 4 800 | – |
| 40 | 80 | 30,2 | 1,1 | 44 000 | 33 500 | 5 600 | – | 7 100 |
| | 80 | 30,2 | 1,1 | 36 500 | 29 000 | 5 600 | 4 800 | – |
| | 90 | 36,5 | 1,5 | 56 500 | 41 000 | 5 300 | – | 6 700 |
| | 90 | 36,5 | 1,5 | 49 500 | 38 000 | 5 300 | 4 500 | – |
| 45 | 85 | 30,2 | 1,1 | 49 500 | 38 000 | 5 000 | – | 6 700 |
| | 85 | 30,2 | 1,1 | 41 500 | 33 500 | 5 000 | 4 300 | – |
| | 100 | 39,7 | 1,5 | 68 500 | 51 000 | 4 500 | – | 6 000 |
| 50 | 90 | 30,2 | 1,1 | 53 000 | 43 500 | 4 800 | – | 6 000 |
| | 90 | 30,2 | 1,1 | 40 500 | 36 000 | 4 800 | 4 000 | – |
| | 110 | 44,4 | 2 | 81 500 | 61 500 | 4 300 | – | 5 600 |
| 55 | 100 | 33,3 | 1,5 | 56 000 | 49 000 | 4 300 | – | 5 600 |
| | 100 | 33,3 | 1,5 | 49 500 | 43 500 | 4 300 | 3 600 | – |
| | 120 | 49,2 | 2 | 95 000 | 73 000 | 3 800 | – | 5 000 |
| 60 | 110 | 36,5 | 1,5 | 69 000 | 62 000 | 3 800 | – | 5 000 |
| | 130 | 54 | 2,1 | 125 000 | 98 500 | 3 400 | – | 4 500 |
| 65 | 120 | 38,1 | 1,5 | 76 500 | 69 000 | 3 600 | – | 4 500 |
| | 140 | 58,7 | 2,1 | 142 000 | 113 000 | 3 200 | – | 4 300 |
| 70 | 125 | 39,7 | 1,5 | 94 000 | 82 000 | 3 400 | – | 4 500 |
| | 150 | 63,5 | 2,1 | 159 000 | 128 000 | 3 000 | – | 3 800 |
| 75 | 130 | 41,3 | 1,5 | 93 500 | 83 000 | 3 200 | – | 4 300 |
| 80 | 140 | 44,4 | 2 | 99 000 | 93 000 | 3 000 | – | 3 800 |
| 85 | 150 | 49.2 | 2 | 116 000 | 110 000 | 2 800 | – | 3 600 |



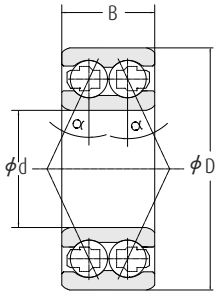

**Dynamic Equivalent Load** $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | | e |
|---|---|---|---|---|
| X | Y | X | Y | |
| 1 | 0.92 | 0.67 | 1.41 | 0.68 |

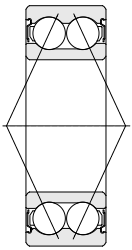
**Static Equivalent Load** $P_0 + F_r + 0.76\,F_a$

| Bearing Designations | | | Load Center Spacings (mm) | Abutment and Fillet Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|---|---|---|---|
| Open | Shielded | Sealed | $a_0$ | $d_a$ min. | $D_a$ max. | $r_a$ max. | approx. |
| 5200 | — | — | 14,5 | 15 | 25 | 0,6 | 0,050 |
| — | 5200ZZ | 5200DDU | 14,5 | 14 | 26 | 0,6 | 0,050 |
| 5201 | — | — | 16,7 | 17 | 27 | 0,6 | 0,060 |
| — | 5201BZZ | 5201BDDU | 16,3 | 16 | 28 | 0,6 | 0,060 |
| 5202 | — | — | 18,3 | 20 | 30 | 0,6 | 0,070 |
| — | 5202BZZ | 5202BDDU | 16,3 | 19 | 31 | 0,6 | 0,070 |
| 5302 | — | — | 22 | 21 | 36 | 1 | 0,13 |
| — | 5302AZZ | 5302ADDU | 21 | 21 | 36 | 1 | 0,13 |
| 5203 | — | — | 20,8 | 22 | 35 | 0,6 | 0,10 |
| — | 5203AZZ | 5203ADDU | 20,1 | 21 | 36 | 0,6 | 0,10 |
| 5303 | — | — | 25 | 23 | 41 | 1 | 0,18 |
| — | 5303AZZ | 5303ADDU | 24,3 | 23 | 41 | 1 | 0,18 |
| 5204 | — | — | 24,3 | 26 | 41 | 1 | 0,16 |
| — | 5204AZZ | 5204ADDU | 23 | 26 | 41 | 1 | 0,16 |
| 5304 | — | — | 26,7 | 27 | 45 | 1 | 0,22 |
| — | 5304AZZ | 5304ADDU | 25,4 | 27 | 45 | 1 | 0,22 |
| 5205 | — | — | 26,8 | 31 | 46 | 1 | 0,18 |
| — | 5205BZZ | 5205BDDU | 25,4 | 31 | 46 | 1 | 0,18 |
| 5305 | — | — | 31,8 | 32 | 55 | 1 | 0,35 |
| — | 5305AZZ | 5305ADDU | 30,9 | 32 | 55 | 1 | 0,36 |
| 5206 | — | — | 31,6 | 36 | 56 | 1 | 0,30 |
| — | 5206BZZ | 5206BDDU | 30,9 | 36 | 56 | 1 | 0,30 |
| 5306 | — | — | 36,5 | 37 | 65 | 1 | 0,57 |
| — | 5306AZZ | 5306ADDU | 36,6 | 37 | 65 | 1 | 0,57 |
| 5207 | — | — | 36,6 | 42 | 65 | 1 | 0,46 |
| — | 5207AZZ | 5207ADDU | 36,3 | 42 | 65 | 1 | 0,46 |
| 5307 | — | — | 41,6 | 44 | 71 | 1,5 | 0,76 |
| — | 5307AZZ | 5307ADDU | 41,5 | 44 | 71 | 1,5 | 0,79 |
| 5208 | — | — | 41,5 | 47 | 73 | 1 | 0,62 |
| — | 5208AZZ | 5208ADDU | 39,4 | 47 | 73 | 1 | 0,63 |
| 5308 | — | — | 45,5 | 49 | 81 | 1,5 | 1,03 |
| — | 5308AZZ | 5308ADDU | 43,8 | 49 | 81 | 1,5 | 1,05 |
| 5209 | — | — | 43,4 | 52 | 78 | 1 | 0,67 |
| — | 5209A1ZZ | 5209A1DDU | 42,5 | 52 | 78 | 1 | 0,67 |
| 5309 | — | — | 50,6 | 54 | 91 | 1,5 | 1,37 |
| 5210 | — | — | 45,9 | 57 | 83 | 1 | 0,72 |
| — | 5210AZZ | 5210ADDU | 44 | 57 | 83 | 1 | 0,73 |
| 5310 | — | — | 55,6 | 60 | 100 | 2 | 1,84 |
| 5211 | — | — | 50,1 | 64 | 91 | 1,5 | 1,01 |
| — | 5211AZZ | 5211ADDU | 49,2 | 64 | 91 | 1,5 | 1,01 |
| 5311 | — | — | 60,6 | 65 | 110 | 2 | 2,40 |
| 5212 | — | — | 56,5 | 69 | 101 | 1,5 | 1,33 |
| 5312 | — | — | 69,2 | 72 | 118 | 2 | 2,92 |
| 5213 | — | — | 59,7 | 74 | 111 | 1,5 | 1,71 |
| 5313 | — | — | 72,8 | 77 | 128 | 2 | 3,67 |
| 5214 | — | — | 63,8 | 79 | 116 | 1,5 | 1,75 |
| 5314 | — | — | 78,3 | 82 | 138 | 2 | 4,55 |
| 5215 | — | — | 66,1 | 84 | 121 | 1,5 | 1,88 |
| 5216 | — | — | 69,6 | 90 | 130 | 2 | 2,51 |
| 5217 | — | — | 75.3 | 95 | 140 | 2 | 3.16 |

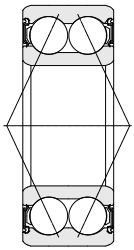
## Double Row | Bore 10–90 mm




Open

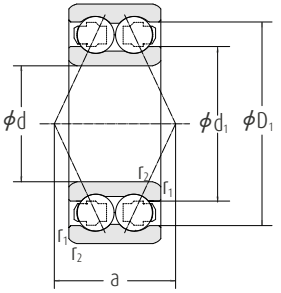


2ZR

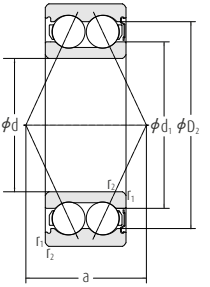


2RSR

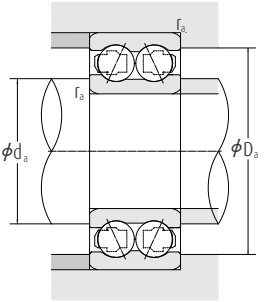
| Dimensions | | | | Abbreviation | | | Load ratings | |
|---|---|---|---|---|---|---|---|---|
| d | D | B | $r_{1,2}$ min | Open | with shields | with seals | dyn. C | stat. $C_0$ |
| | mm | | | | 2ZR | 2RSR | kN | |
| **10** | 30 | 14.0 | 0.6 | 3200BTNG | ..B2ZRTNG | ..B2RSRTNG | 7.80 | 4.55 |
| **12** | 32 | 15.9 | 0.6 | 3201BTNG | ..B2ZRTNG | ..B2RSRTNG | 10.60 | 5.85 |
| | 37 | 19.0 | 1.0 | 3301BTNG | ..B2ZRTNG | ..B2RSRTNG | 14.50 | 8.20 |
| **15** | 35 | 15.9 | 0.6 | 3202BTNG | ..B2ZRTNG | ..B2RSRTNG | 11.80 | 7.10 |
| | 42 | 19.0 | 1.0 | 3302BTNG | ..B2ZRTNG | ..B2RSRTNG | 16.30 | 10.00 |
| **17** | 40 | 17.5 | 0.6 | 3203BTNG | ..B2ZRTNG | ..B2RSRTNG | 14.60 | 9.00 |
| | 47 | 22.2 | 1.0 | 3303BTNG | ..B2ZRTNG | ..B2RSRTNG | 20.80 | 12.50 |
| **20** | 47 | 20.6 | 1.0 | 3204BTNG | ..B2ZRTNG | ..B2RSRTNG | 19.60 | 12.50 |
| | 52 | 22.2 | 1.1 | 3304BTNG | ..B2ZRTNG | ..B2RSRTNG | 23.20 | 15.00 |
| **25** | 52 | 20.6 | 1.0 | 3205BTNG | ..B2ZRTNG | ..B2RSRTNG | 21.20 | 14.60 |
| | 62 | 25.4 | 1.1 | 3305BTNG | ..B2ZRTNG | ..B2RSRTNG | 30.00 | 20.00 |
| **30** | 62 | 23.8 | 1.0 | 3206BTNG | ..B2ZRTNG | ..B2RSRTNG | 30.00 | 21.20 |
| | 72 | 30.2 | 1.1 | 3306BTNG | ..B2ZRTNG | ..B2RSRTNG | 41.50 | 28.50 |
| **35** | 72 | 27.0 | 1.1 | 3207BTNG | ..B2ZRTNG | ..B2RSRTNG | 39.00 | 28.50 |
| | 80 | 34.9 | 1.5 | 3307BTNG | ..B2ZRTNG | ..B2RSRTNG | 51.00 | 34.50 |
| **40** | 80 | 30.2 | 1.1 | 3208BTNG | ..B2ZRTNG | ..B2RSRTNG | 48.00 | 36.50 |
| | 90 | 36.5 | 1.5 | 3308BTNG | ..B2ZRTNG | ..B2RSRTNG | 62.00 | 45.00 |
| **45** | 85 | 30.2 | 1.1 | 3209BTNG | ..B2ZRTNG | ..B2RSRTNG | 48.00 | 37.50 |
| | 100 | 39.7 | 1.5 | 3309BTNG | ..B2ZRTNG | ..B2RSRTNG | 68.00 | 51.00 |
| **50** | 90 | 30.2 | 1.1 | 3210BTNG | ..B2ZRTNG | ..B2RSRTNG | 51.00 | 42.50 |
| | 110 | 44.4 | 2.0 | 3310BTNG | ..B2ZRTNG | ..B2RSRTNG | 81.00 | 62.00 |
| **55** | 100 | 33.3 | 1.5 | 3211BTNG | ..B2ZRTNG | ..B2RSRTNG | 58.50 | 49.00 |
| | 120 | 49.2 | 2.0 | 3311BTNG | ..B2ZRTNG | ..B2RSRTNG | 102.00 | 78.00 |
| **60** | 110 | 36.5 | 1.5 | 3212BTNG | ..B2ZRTNG | ..B2RSRTNG | 72.00 | 61.00 |
| | 130 | 54.0 | 2.1 | 3312BTNG | ..B2ZRTNG | ..B2RSRTNG | 125.00 | 98.00 |
| **65** | 120 | 38.1 | 1.5 | 3213BTNG | ..B2ZRTNG | ..B2RSRTNG | 80.00 | 73.50 |
| | 140 | 58.7 | 2.1 | 3313BTNG | ..B2ZRTNG | ..B2RSRTNG | 150.00 | 118.00 |
| **70** | 125 | 39.7 | 1.5 | 3214BTNG | ..B2ZRTNG | ..B2RSRTNG | 83.00 | 76.50 |
| | 150 | 63.5 | 2.1 | 3314BTNG | ..B2ZRTNG | ..B2RSRTNG | 171.50 | 138.20 |
| **75** | 130 | 41.3 | 1.5 | 3215BTNG | ..B2ZRTNG | ..B2RSRTNG | 91.50 | 85.00 |
| | 160 | 68.3 | 2.1 | 3315BTNG | ..B2ZRTNG | ..B2RSRTNG | 173.40 | 145.30 |
| **80** | 140 | 44.4 | 2.0 | 3216BTNG | ..B2ZRTNG | ..B2RSRTNG | 98.00 | 93.00 |
| **85** | 150 | 49.2 | 2.0 | 3217BTNG | ..B2ZRTNG | ..B2RSRTNG | 116.00 | 110.00 |
| **90** | 160 | 52.4 | 2.0 | 3218BTNG | ..B2ZRTNG | ..B2RSRTNG | 124.60 | 120.30 |




Open

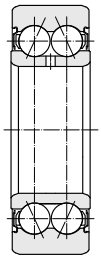



ZR, RSR

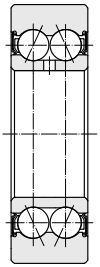



| Speed limits | | Dimensions (mm) | | | Abutment dimensions (mm) | | | Weight |
|---|---|---|---|---|---|---|---|---|
| Grease | Oil | | | | | | | |
| $min^{-1}$ | | $d_1$ | $D_1$, $D_2$ | a min | $d_a$ max | $D_a$ max | $r_a$ max | kg |
| 16,000 | 22,000 | 17.9 | 23.9 | 15.1 | 15 | 25.0 | 0.6 | 0.043 |
| 15,000 | 20,000 | 18.3 | 25.7 | 16.6 | 17 | 27.0 | 0.6 | 0.051 |
| 10,500 | 11,500 | 21.1 | 30.4 | 19.4 | 19 | 32.0 | 1.0 | 0.090 |
| 14,000 | 19,000 | 21.0 | 29.3 | 18.0 | 20 | 30.0 | 0.6 | 0.058 |
| 11,000 | 16,000 | 25.6 | 34.2 | 21.2 | 21 | 36.0 | 1.0 | 0.112 |
| 12,000 | 17,000 | 24.0 | 33.1 | 20.5 | 22 | 35.0 | 0.6 | 0.085 |
| 10,000 | 15,000 | 26.2 | 37.7 | 24.0 | 23 | 41.0 | 1.0 | 0.161 |
| 10,000 | 15,000 | 28.9 | 38.7 | 24.2 | 26 | 41.0 | 1.0 | 0.139 |
| 9,000 | 13,000 | 31.2 | 42.6 | 26.4 | 27 | 45.0 | 1.0 | 0.197 |
| 8,500 | 12,000 | 33.9 | 43.7 | 26.5 | 31 | 46.0 | 1.0 | 0.159 |
| 7,500 | 10,000 | 37.1 | 50.0 | 30.7 | 32 | 55.0 | 1.0 | 0.316 |
| 7,000 | 9,500 | 40.0 | 52.7 | 31.4 | 36 | 56.0 | 1.0 | 0.265 |
| 6,300 | 8500 | 44.0 | 59.0 | 36.2 | 37 | 65.0 | 1.0 | 0.496 |
| 6,300 | 8,500 | 47.2 | 60.4 | 36.6 | 42 | 65.0 | 1.0 | 0.412 |
| 5,600 | 7,500 | 49.2 | 65.4 | 41.5 | 44 | 71.0 | 1.5 | 0.664 |
| 5,600 | 7,500 | 52.9 | 67.9 | 40.9 | 47 | 73.0 | 1.0 | 0.550 |
| 5,000 | 6700 | 55.4 | 74.3 | 46.1 | 49 | 81.0 | 1.5 | 0.905 |
| 5,000 | 6,700 | 57.1 | 72.6 | 43.2 | 52 | 78.0 | 1.0 | 0.583 |
| 4,500 | 6,000 | 62.2 | 81.6 | 50.0 | 54 | 91.0 | 1.5 | 1.210 |
| 4,800 | 6,300 | 61.9 | 78.1 | 45.5 | 57 | 83.0 | 1.0 | 0.632 |
| 4,000 | 5,300 | 68.2 | 89.6 | 54.9 | 60 | 100.0 | 2.0 | 1.600 |
| 4,300 | 5,600 | 68.6 | 85.3 | 49.9 | 64 | 91.0 | 1.5 | 0.876 |
| 3,800 | 5,000 | 75.2 | 98.4 | 61.2 | 65 | 110.0 | 2.0 | 2.110 |
| 3,800 | 5,000 | 75.7 | 94.3 | 55.1 | 69 | 101.0 | 1.5 | 1.180 |
| 3,400 | 4,500 | 81.2 | 108.7 | 67.3 | 72 | 118.0 | 2.0 | 2.700 |
| 3,400 | 4,500 | 84.5 | 103.5 | 59.8 | 74 | 111.0 | 1.5 | 1.520 |
| 3,200 | 4,300 | 88.2 | 118.0 | 73.3 | 77 | 128.0 | 2.0 | 3.390 |
| 3,400 | 4,500 | 86.7 | 106.2 | 61.6 | 79 | 116.0 | 1.5 | 1.640 |
| 3,000 | 4,000 | 94.7 | 125.0 | 80.8 | 84 | 135.0 | 2.1 | 4.900 |
| 3,200 | 4,300 | 92.4 | 112.6 | 65.0 | 89 | 116.6 | 1.5 | 1.910 |
| 2,800 | 3,800 | 101.4 | 133.0 | 83.8 | 90 | 143.0 | 2.1 | 5.700 |
| 3,000 | 4,000 | 98.5 | 120.3 | 69.0 | 91 | 129.0 | 2.0 | 2.450 |
| 2,800 | 3,800 | 106.4 | 128.5 | 74.6 | 100 | 135.0 | 2.0 | 3.300 |
| 2,600 | 3,600 | 113.2 | 136.6 | 78.9 | 109 | 141.0 | 2.1 | 4.170 |

## Bore 10–35 mm



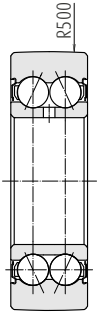
LZ..2ZR



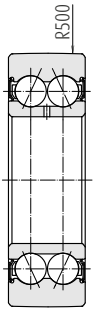
LZ..2RSR

| Dimensions | | | | Abbreviation for | |
|---|---|---|---|---|---|
| d | D* | B | $r_s$ min | Shields | Seals |
| | | mm | | | |
| **10** | 32 | 14.0 | 0.6 | LZ3200B2ZRSTNG | LZ3200B2RSRSTNG |
| | 32 | 14.0 | 0.6 | LB3200B2ZRSTNG | LB3200B2RSRSTNG |
| **12** | 35 | 15.9 | 0.6 | LZ3201B2ZRSTNG | LZ3201B2RSRSTNG |
| | 35 | 15.9 | 0.6 | LB3201B2ZRSTNG | LB3201B2RSRSTNG |
| **15** | 40 | 15.9 | 0.6 | LZ3202B2ZRSTNG | LZ3202B2RSRSTNG |
| | 40 | 15.9 | 0.6 | LB3202B2ZRSTNG | LB3202B2RSRSTNG |
| **17** | 47 | 17.5 | 0.6 | LZ3203B2ZRSTNG | LZ3203B2RSRSTNG |
| | 47 | 17.5 | 0.6 | LB3203B2ZRSTNG | LB3203B2RSRSTNG |
| **20** | 52 | 20.6 | 1.0 | LZ3204B2ZRSTNG | LZ3204B2RSRSTNG |
| | 52 | 20.6 | 1.0 | LB3204B2ZRSTNG | LB3204B2RSRSTNG |
| **25** | 62 | 20.6 | 1.0 | LZ3205B2ZRSTNG | LZ3205B2RSRSTNG |
| | 62 | 20.6 | 1.0 | LB3205B2ZRSTNG | LB3205B2RSRSTNG |
| **30** | 72 | 23.8 | 1.0 | LZ3206B2ZRSTNG | LZ3206B2RSRSTNG |
| | 72 | 23.8 | 1.0 | LB3206B2ZRSTNG | LB3206B2RSRSTNG |
| **35** | 80 | 27.0 | 1.0 | LZ3207B2ZRSTNG | LZ3207B2RSRSTNG |
| | 80 | 27.0 | 1.0 | LB3207B2ZRSTNG | LB3207B2RSRSTNG |

* with spherical outer ring D 0.05 mm



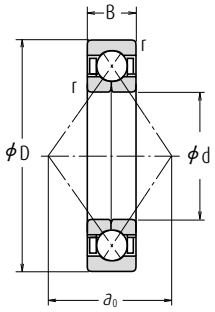

LB..2ZR




LB..2RSR

| Load ratings [kN] | | | | Speed limits | Weight |
|---|---|---|---|---|---|
| Bearing | | Pulley | | | |
| dyn. C | stat. $C_0$ | dyn. C | stat. $C_0$ | $min^{-1}$ | kg |
| 7.8 | 4.55 | 7.45 | 4.15 | 16 000 | 0.061 |
| 7.8 | 4.55 | 7.45 | 4.15 | 16 000 | 0.061 |
| 10.6 | 5.85 | 9.95 | 5.20 | 15 000 | 0.079 |
| 10.6 | 5.85 | 9.95 | 5.20 | 15 000 | 0.079 |
| 11.8 | 7.10 | 11.00 | 6.45 | 13 000 | 0.100 |
| 11.8 | 7.10 | 11.00 | 6.45 | 13 000 | 0.100 |
| 14.6 | 9.00 | 13.80 | 8.30 | 10 000 | 0.165 |
| 14.6 | 9.00 | 13.80 | 8.30 | 10 000 | 0.165 |
| 19.6 | 12.50 | 18.30 | 11.00 | 9 000 | 0.210 |
| 19.6 | 12.50 | 18.30 | 11.00 | 9 000 | 0.210 |
| 21.2 | 14.60 | 19.90 | 13.40 | 8 000 | 0.330 |
| 21.2 | 14.60 | 19.90 | 13.40 | 8 000 | 0.330 |
| 30.0 | 21.20 | 27.90 | 18.60 | 7 100 | 0.500 |
| 30.0 | 21.20 | 27.90 | 18.60 | 7 100 | 0.500 |
| 39.0 | 28.50 | 36.20 | 25.0 | 6 300 | 0.660 |
| 39.0 | 28.50 | 36.20 | 25.0 | 6 300 | 0.660 |

## Bore Diameter 30 – 95 mm

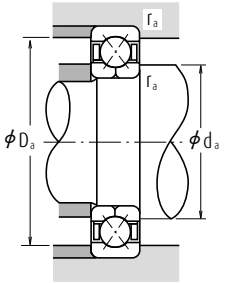



| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Limiting Speeds (min-1) | |
|---|---|---|---|---|---|---|---|
| d | D | B | r min. | $C_a$ | $C_{0a}$ | Grease | Oil |
| **30** | 62 | 16 | 1 | 31 000 | 45 000 | 8 500 | 12 000 |
| | 72 | 19 | 1.1 | 46 000 | 63 000 | 8 000 | 11 000 |
| **35** | 72 | 17 | 1.1 | 41 000 | 61 500 | 7 500 | 10 000 |
| | 80 | 21 | 1.5 | 55 000 | 80 000 | 7 100 | 9 500 |
| **40** | 80 | 18 | 1.1 | 49 000 | 77 500 | 6 700 | 9 000 |
| | 90 | 23 | 1.5 | 67 000 | 100 000 | 6 300 | 8 500 |
| **45** | 85 | 19 | 1.1 | 55 000 | 88 500 | 6 300 | 8 500 |
| | 100 | 25 | 1.5 | 87 500 | 133 000 | 5 600 | 7 500 |
| **50** | 90 | 20 | 1.1 | 57 000 | 97 000 | 5 600 | 8 000 |
| | 110 | 27 | 2 | 102 000 | 159 000 | 5 000 | 6 700 |
| **55** | 100 | 21 | 1.5 | 71 000 | 122 000 | 5 300 | 7 100 |
| | 120 | 29 | 2 | 118 000 | 187 000 | 4 500 | 6 300 |
| **60** | 110 | 22 | 1.5 | 85 500 | 150 000 | 4 800 | 6 300 |
| | 130 | 31 | 2.1 | 135 000 | 217 000 | 4 300 | 5 600 |
| **65** | 120 | 23 | 1.5 | 97 500 | 179 000 | 4 300 | 6 000 |
| | 140 | 33 | 2.1 | 153 000 | 250 000 | 3 800 | 5 300 |
| **70** | 125 | 24 | 1.5 | 106 000 | 197 000 | 4 000 | 5 600 |
| | 150 | 35 | 2.1 | 172 000 | 285 000 | 3 600 | 5 000 |
| **75** | 130 | 25 | 1.5 | 110 000 | 212 000 | 3 800 | 5 300 |
| | 160 | 37 | 2.1 | 187 000 | 320 000 | 3 400 | 4 800 |
| **80** | 125 | 22 | 1.1 | 77 000 | 167 000 | 3 800 | 5 300 |
| | 140 | 26 | 2 | 124 000 | 236 000 | 3 600 | 5 000 |
| | 170 | 39 | 2.1 | 202 000 | 360 000 | 3 200 | 4 300 |
| **85** | 130 | 22 | 1.1 | 79 000 | 176 000 | 3 800 | 5 000 |
| | 150 | 28 | 2 | 143 000 | 276 000 | 3 400 | 4 800 |
| | 180 | 41 | 3 | 218 000 | 405 000 | 3 000 | 4 000 |
| **90** | 140 | 24 | 1.5 | 94 000 | 208 000 | 3 400 | 4 800 |
| | 160 | 30 | 2 | 164 000 | 320 000 | 3 200 | 4 300 |
| | 190 | 43 | 3 | 235 000 | 450 000 | 2 800 | 3 800 |
| **95** | 145 | 24 | 1.5 | 96 500 | 220 000 | 3 400 | 4 500 |
| | 170 | 32 | 2.1 | 177 000 | 340 000 | 3 000 | 4 000 |
| | 200 | 45 | 3 | 251 000 | 495 000 | 2 600 | 3 600 |

**Remark** When using four-point contact ball bearings, please contact NSK.

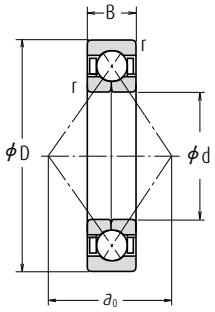
Dynamic Equivalent Load $P_a=F_a$

Static Equivalent Load $P_{0a}=F_a$




| Bearing Numbers | Load Center Spacings (mm) | Abutment and Fillet Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|---|---|
| | $a_0$ | $d_a$ min. | $D_a$ max. | $r_a$ max. | approx. |
| **QJ 206** | 32.2 | 36 | 56 | 1 | 0.24 |
| **QJ 306** | 35.7 | 37 | 65 | 1 | 0.42 |
| **QJ 207** | 37.5 | 42 | 65 | 1 | 0.35 |
| **QJ 307** | 40.3 | 44 | 71 | 1.5 | 0.57 |
| **QJ 208** | 42.0 | 47 | 73 | 1 | 0.45 |
| **QJ 308** | 45.5 | 49 | 81 | 1.5 | 0.78 |
| **QJ 209** | 45.5 | 52 | 78 | 1 | 0.52 |
| **QJ 309** | 50.8 | 54 | 91 | 1.5 | 1.05 |
| **QJ 210** | 49.0 | 57 | 83 | 1 | 0.59 |
| **QJ 310** | 56.0 | 60 | 100 | 2 | 1.35 |
| **QJ 211** | 54.3 | 64 | 91 | 1.5 | 0.77 |
| **QJ 311** | 61.3 | 65 | 110 | 2 | 1.75 |
| **QJ 212** | 59.5 | 69 | 101 | 1.5 | 0.98 |
| **QJ 312** | 66.5 | 72 | 118 | 2 | 2.15 |
| **QJ 213** | 64.8 | 74 | 111 | 1.5 | 1.2 |
| **QJ 313** | 71.8 | 77 | 128 | 2 | 2.7 |
| **QJ 214** | 68.3 | 79 | 116 | 1.5 | 1.3 |
| **QJ 314** | 77.0 | 82 | 138 | 2 | 3.18 |
| **QJ 215** | 71.8 | 84 | 121 | 1.5 | 1.5 |
| **QJ 315** | 82.3 | 87 | 148 | 2 | 3.9 |
| **QJ 1016** | 71.8 | 87 | 118 | 1 | 1.05 |
| **QJ 216** | 77.0 | 90 | 130 | 2 | 1.85 |
| **QJ 316** | 87.5 | 92 | 158 | 2 | 4.6 |
| **QJ 1017** | 75.3 | 92 | 123 | 1 | 1.1 |
| **QJ 217** | 82.3 | 95 | 140 | 2 | 2.2 |
| **QJ 317** | 92.8 | 99 | 166 | 2.5 | 5.34 |
| **QJ 1018** | 80.5 | 99 | 131 | 1.5 | 1.45 |
| **QJ 218** | 87.5 | 100 | 150 | 2 | 2.75 |
| **QJ 318** | 98.0 | 104 | 176 | 2.5 | 6.4 |
| **QJ 1019** | 84.0 | 104 | 136 | 1.5 | 1.5 |
| **QJ 219** | 92.8 | 107 | 158 | 2 | 3.35 |
| **QJ 319** | 103.3 | 109 | 186 | 2.5 | 7.4 |

## Bore Diameter 100 – 200 mm

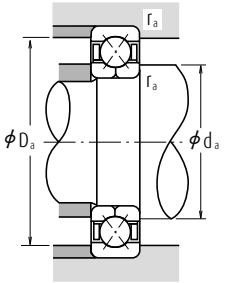



| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Limiting Speeds (min-1) | |
|---|---|---|---|---|---|---|---|
| d | D | B | r min. | $C_a$ | $C_{0a}$ | Grease | Oil |
| **100** | 150 | 24 | 1.5 | 98 500 | 232 000 | 3 200 | 4 300 |
| | 180 | 34 | 2.1 | 199 000 | 390 000 | 2 800 | 3 800 |
| | 215 | 47 | 3 | 300 000 | 640 000 | 2 400 | 3 400 |
| **105** | 160 | 26 | 2 | 115 000 | 269 000 | 3 000 | 4 000 |
| | 190 | 36 | 2.1 | 217 000 | 435 000 | 2 600 | 3 600 |
| | 225 | 49 | 3 | 305 000 | 640 000 | 2 400 | 3 200 |
| **110** | 170 | 28 | 2 | 139 000 | 315 000 | 2 800 | 3 800 |
| | 200 | 38 | 2.1 | 235 000 | 490 000 | 2 600 | 3 400 |
| | 240 | 50 | 3 | 320 000 | 710 000 | 2 200 | 3 000 |
| **120** | 180 | 28 | 2 | 147 000 | 350 000 | 2 600 | 3 600 |
| | 215 | 40 | 2.1 | 265 000 | 585 000 | 2 400 | 3 200 |
| | 260 | 55 | 3 | 360 000 | 835 000 | 2 000 | 2 800 |
| **130** | 200 | 33 | 2 | 169 000 | 415 000 | 2 400 | 3 200 |
| | 230 | 40 | 3 | 274 000 | 635 000 | 2 200 | 3 000 |
| | 280 | 58 | 4 | 400 000 | 970 000 | 1 900 | 2 600 |
| **140** | 210 | 33 | 2 | 172 000 | 435 000 | 2 200 | 3 000 |
| | 250 | 42 | 3 | 239 000 | 710 000 | 2 000 | 2 800 |
| | 300 | 62 | 4 | 440 000 | 1 110 000 | 1 700 | 2 400 |
| **150** | 225 | 35 | 2.1 | 197 000 | 505 000 | 2 000 | 2 800 |
| | 270 | 45 | 3 | 315 000 | 785 000 | 1 800 | 2 600 |
| | 320 | 65 | 4 | 460 000 | 1 230 000 | 1 600 | 2 200 |
| **160** | 240 | 38 | 2.1 | 224 000 | 580 000 | 1 900 | 2 600 |
| | 290 | 48 | 3 | 380 000 | 1 010 000 | 1 700 | 2 400 |
| | 340 | 68 | 4 | 505 000 | 1 400 000 | 1 500 | 2 000 |
| **170** | 260 | 42 | 2.1 | 268 000 | 705 000 | 1 800 | 2 400 |
| | 310 | 52 | 4 | 425 000 | 1 180 000 | 1 600 | 2 200 |
| | 360 | 72 | 4 | 565 000 | 1 610 000 | 1 400 | 2 000 |
| **180** | 280 | 46 | 2.1 | 299 000 | 830 000 | 1 700 | 2 200 |
| | 320 | 52 | 4 | 440 000 | 1 270 000 | 1 500 | 2 000 |
| | 380 | 75 | 4 | 595 000 | 1 770 000 | 1 300 | 1 800 |
| **190** | 290 | 46 | 2.1 | 325 000 | 925 000 | 1 600 | 2 200 |
| | 340 | 55 | 4 | 440 000 | 1 290 000 | 1 400 | 2 000 |
| | 400 | 78 | 5 | 655 000 | 1 980 000 | 1 300 | 1 700 |
| **200** | 310 | 51 | 2.1 | 345 000 | 1 020 000 | 1 500 | 2 000 |
| | 360 | 58 | 4 | 490 000 | 1 480 000 | 1 300 | 1 800 |
| | 420 | 80 | 5 | 690 000 | 2 180 000 | 1 200 | 1 600 |

**Remark** When using four-point contact ball bearings, please contact NSK.

Dynamic Equivalent Load $P_a=F_a$

Static Equivalent Load $P_{0a}=F_a$




| Bearing Numbers | Load Center Spacings (mm) | Abutment and Fillet Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|---|---|
| | $a_0$ | $d_a$ min. | $D_a$ max. | $r_a$ max. | approx. |
| **QJ 1020** | 87.5 | 109 | 141 | 1.5 | 1.6 |
| **QJ 220** | 98.0 | 112 | 168 | 2 | 4.0 |
| **QJ 320** | 110.3 | 114 | 201 | 2.5 | 9.3 |
| **QJ 1021** | 92.8 | 115 | 150 | 2 | 2.0 |
| **QJ 221** | 103.3 | 117 | 178 | 2 | 4.7 |
| **QJ 321** | 115.5 | 119 | 211 | 2.5 | 10.5 |
| **QJ 1022** | 98.0 | 120 | 160 | 2 | 2.5 |
| **QJ 222** | 108.5 | 122 | 188 | 2 | 5.6 |
| **QJ 322** | 122.5 | 124 | 226 | 2.5 | 12.5 |
| **QJ 1024** | 105.0 | 130 | 170 | 2 | 2.65 |
| **QJ 224** | 117.3 | 132 | 203 | 2 | 6.9 |
| **QJ 324** | 133.0 | 134 | 246 | 2.5 | 15.4 |
| **QJ 1026** | 115.5 | 140 | 190 | 2 | 4.0 |
| **QJ 226** | 126.0 | 144 | 216 | 2.5 | 7.7 |
| **QJ 326** | 143.5 | 148 | 262 | 3 | 19 |
| **QJ 1028** | 122.5 | 150 | 200 | 2 | 4.3 |
| **QJ 228** | 136.5 | 154 | 236 | 2.5 | 9.8 |
| **QJ 328** | 154.0 | 158 | 282 | 3 | 24 |
| **QJ 1030** | 131.3 | 162 | 213 | 2 | 5.2 |
| **QJ 230** | 147.0 | 164 | 256 | 2.5 | 12 |
| **QJ 330** | 164.5 | 168 | 302 | 3 | 29 |
| **QJ 1032** | 140.0 | 172 | 228 | 2 | 6.4 |
| **QJ 232** | 157.5 | 174 | 276 | 2.5 | 15 |
| **QJ 332** | 175.1 | 178 | 322 | 3 | 31 |
| **QJ 1034** | 150.5 | 182 | 248 | 2 | 8.6 |
| **QJ 234** | 168.0 | 188 | 292 | 3 | 19.5 |
| **QJ 334** | 185.6 | 188 | 342 | 3 | 41 |
| **QJ 1036** | 161.0 | 192 | 268 | 2 | 11 |
| **QJ 236** | 175.1 | 198 | 302 | 3 | 20.5 |
| **QJ 336** | 196.1 | 198 | 362 | 3 | 48 |
| **QJ 1038** | 168.0 | 202 | 278 | 2 | 11.5 |
| **QJ 238** | 185.6 | 208 | 322 | 3 | 23 |
| **QJ 338** | 206.6 | 212 | 378 | 4 | 54.5 |
| **QJ 1040** | 178.6 | 212 | 298 | 2 | 15 |
| **QJ 240** | 196.1 | 218 | 342 | 3 | 27 |
| **QJ 340** | 217.1 | 222 | 398 | 4 | 61.5 |


NSK

## 4. SELF-ALIGNING BALL BEARINGS


Page

Introduction ..... B 120

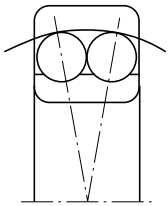

## BEARINGS TABLE

## SELF-ALIGNING BALL BEARINGS


Bore Dia. Page

5 – 110 mm ..... B 122

## DESIGN, TYPES, AND FEATURES

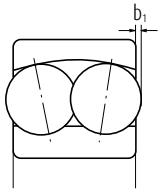


The outer ring has a spherical raceway and its center of curvature coincides with that of the bearing; therefore, the axis of the inner ring, balls and cage can deflect to some extent around the bearing center. This type is recommended when the alignment of the shaft and housing is difficult and when the shaft may bend. Since the contact angle is small, the axial load capacity is low.

Pressed steel cages are usually used.

## PROTRUSION AMOUNT OF BALLS

Among self-aligning ball bearings, there are some in which the balls protrude from the side face as shown below. This protrusion amount $b_1$ is listed in the following table.




| Bearing No. | $b_1$ (mm) |
|---|---|
| 2222(K), 2316(K) | 0.5 |
| 2319(K), 2320(K)<br>2321, 2322(K) | 0.5 |
| 1318(K) | 1.5 |
| 1319(K) | 2 |
| 1320(K), 1321<br>1322(K) | 3 |


| | Tables | Pages |
|---|---|---|
| Tolerances and Running Accuracy | 7.2 | A128 to A131 |
| Recommended Fits | 8.3 | A164 |
| | 8.5 | A165 |
| Internal Clearance | 8.13 | A170 |


## PERMISSIBLE MISALIGNMENT

The permissible misalignment of self-aligning ball bearings is approximately 0.07 to 0.12 radian (4° to 7°) under normal loads. However, depending on the surrounding structure, such an angle may not be possible. Use care in the structural design.

## CAGES

The cages of these bearings are made of pressed steel of glass-fibre reinforced Polyamid 66.
Suffix

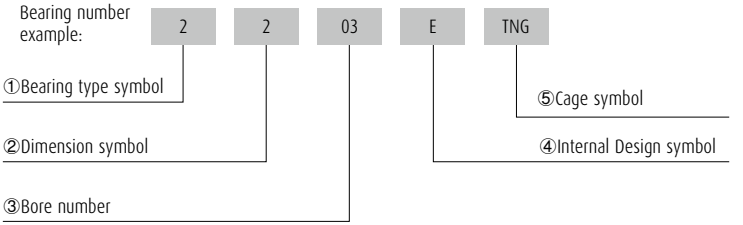
- (blank) - pressed steel
- J - pressed steel
- TN/TNG - Polyamide 66

## SEALS

NSK manufactures Series 22.. and 23.. Self Aligning Ball Bearings, not only as an open version but also with seals on both sides of the bearing. These seals are made of nitrile rubber and are reinforced with a steel disc embedded in the rubber. The seals are fixed in the outer ring and seal against the inner ring with a friction sealing lip. Sealed Self Aligning Ball Bearings are filled with enough grease at the factory to last the normal life span of the bearing. The bearings are therefore maintenance free. Note that sealed Self Aligning Bearings have a lower load-carrying capacity than open bearings of the same type. During installation, it is essential that they are not twisted, as otherwise the seals may be forced out of position.

## ANGLE ADJUSTMENT FACILITY

Self Aligning Bearings facilitate angle adjustment. The permitted angle of tilt from the central position for Series 12.. and 22.. open bearings is 2.5° and for Series 13.. and 23.. is 3°. With sealed bearings, the permitted angle of tilt is 1.5°.




①Self Aligning Ball Bearing

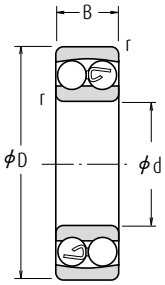
②1: series, 2: 2 series

③Less than 03, Bearing bore 00 : 10 mm, 01 : 12 mm,
02 : 15 mm, 03 : 17 mm
Over 04, Bearing bore Bore number ×5 (mm)

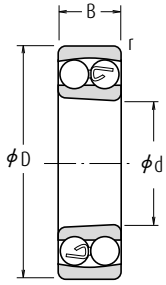
④E: High Load Capacity

⑤(blank)/J: Pressed Steel Cage
TN/TNG Polyamide Cage

## Bore Diameter 5 – 17 mm




Cylindrical Bore

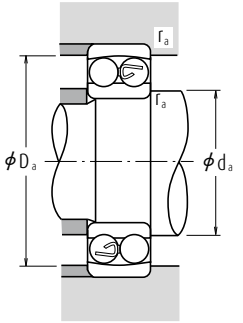



Tapered Bore

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Limiting Speeds (min$^{-1}$) | | Bearing |
|---|---|---|---|---|---|---|---|---|
| d | D | B | r min. | $C_r$ | $C_{0r}$ | Grease | Oil | Cylindrical Bore |
| **5** | 19 | 6 | 0.3 | 2 530 | 475 | 30 000 | 36 000 | **135** |
| **6** | 19 | 6 | 0.3 | 2 530 | 475 | 30 000 | 36 000 | **126** |
| **7** | 22 | 7 | 0.3 | 2 750 | 600 | 26 000 | 32 000 | **127** |
| **8** | 22 | 7 | 0.3 | 2 750 | 600 | 26 000 | 32 000 | **108** |
| **9** | 26 | 8 | 0.6 | 4 150 | 895 | 26 000 | 30 000 | **129** |
| **10** | 30 | 9 | 0.6 | 5 550 | 1 190 | 22 000 | 28 000 | **1200** |
| | 30 | 9 | 0.6 | 5 500 | 1 530 | 24 000 | 30 000 | **1200TN** |
| | 30 | 14 | 0.6 | 7 450 | 1 590 | 24 000 | 28 000 | **2200** |
| | 30 | 14 | 0.6 | 7 200 | 2 040 | 24 000 | 30 000 | **2200TN** |
| | 35 | 11 | 0.6 | 7 350 | 1 620 | 20 000 | 24 000 | **1300** |
| | 35 | 17 | 0.6 | 9 200 | 2 010 | 18 000 | 22 000 | **2300** |
| **12** | 32 | 10 | 0.6 | 5 700 | 1 270 | 22 000 | 26 000 | **1201** |
| | 32 | 10 | 0.6 | 5 600 | 1 270 | 24 000 | 30 000 | **1201TNG** |
| | 32 | 14 | 0.6 | 7 750 | 1 730 | 22 000 | 26 000 | **2201** |
| | 32 | 14 | 0.6 | 9 000 | 1 960 | 20 000 | 26 000 | **2201ETNG** |
| | 37 | 12 | 1.0 | 9 650 | 2 160 | 18 000 | 22 000 | **1301** |
| | 37 | 12 | 1.0 | 9 500 | 2 160 | 18 000 | 22 000 | **1301TN** |
| | 37 | 17 | 1.0 | 12 100 | 2 730 | 17 000 | 22 000 | **2301** |
| **15** | 35 | 11 | 0.6 | 7 600 | 1 750 | 18 000 | 22 000 | **1202** |
| | 35 | 11 | 0.6 | 7 500 | 1 760 | 20 000 | 26 000 | **1202TNG** |
| | 35 | 14 | 0.6 | 7 800 | 1 850 | 18 000 | 22 000 | **2202** |
| | 35 | 14 | 0.6 | 9 150 | 2 080 | 19 000 | 24 000 | **2202ETNG** |
| | 42 | 13 | 1.0 | 9 700 | 2 290 | 16 000 | 20 000 | **1302** |
| | 42 | 13 | 1.0 | 9 500 | 2 280 | 17 000 | 20 000 | **1302TN** |
| | 42 | 17 | 1.0 | 12 300 | 2 910 | 14 000 | 18 000 | **2302** |
| | 42 | 17 | 1.0 | 12 000 | 2 900 | 16 000 | 19 000 | **2302ETNG** |
| **17** | 40 | 12 | 0.6 | 8 000 | 2 010 | 16 000 | 20 000 | **1203** |
| | 40 | 12 | 0.6 | 8 000 | 2 040 | 18 000 | 22 000 | **1203TNG** |
| | 40 | 16 | 0.6 | 9 950 | 2 420 | 16 000 | 20 000 | **2203** |
| | 40 | 16 | 0.6 | 11 400 | 2 750 | 16 000 | 19 000 | **2203ETNG** |
| | 47 | 14 | 1.0 | 12 700 | 3 200 | 14 000 | 17 000 | **1303** |
| | 47 | 14 | 1.0 | 12 500 | 3 200 | 15 000 | 18 000 | **1303TN** |
| | 47 | 19 | 1.0 | 14 700 | 3 550 | 13 000 | 16 000 | **2303** |
| | 47 | 19 | 1.0 | 14 300 | 3 550 | 14 000 | 17 000 | **2303TN** |

Note (1) The suffix K represents bearings with tapered bores (1 : 12)

Remark For the dimensions related to adapters, refer to Page **B376**.




## Dynamic Equivalent Load $P=XF_r+YF_a$

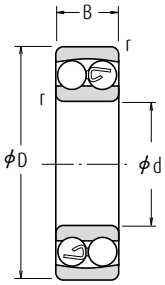
| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | $Y_3$ | 0.65 | $Y_2$ |

## Static Equivalent Load $P_0=F_r+Y_0F_a$

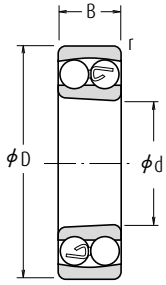
The values of e, $Y_2$ , $Y_3$ , and $Y_0$ are listed in the table below.

| Numbers | Abutment and Fillet Dimensions (mm) | | | Constant | Axial Load Factors | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|
| Tapered Bore(1) | $d_a$ min. | $D_a$ max. | $r_a$ max. | e | $Y_2$ | $Y_3$ | $Y_0$ | approx. |
| — | 7.0 | 17.0 | 0.3 | 0.34 | 2.9 | 1.9 | 1.9 | 0.009 |
| — | 8.0 | 17.0 | 0.3 | 0.34 | 2.9 | 1.9 | 1.9 | 0.008 |
| — | 9.0 | 20.0 | 0.3 | 0.31 | 3.1 | 2.0 | 2.1 | 0.013 |
| — | 10.0 | 20.0 | 0.3 | 0.31 | 3.1 | 2.0 | 2.1 | 0.016 |
| — | 13.0 | 22.0 | 0.6 | 0.32 | 3.1 | 2.0 | 2.1 | 0.021 |
| — | 14.0 | 26.0 | 0.6 | 0.32 | 3.1 | 2.0 | 2.1 | 0.034 |
| — | 14.0 | 26.0 | 0.6 | 0.32 | 3.00 | 2.0 | 2.1 | 0.034 |
| — | 14.0 | 26.0 | 0.6 | 0.64 | 1.5 | 0.98 | 1.0 | 0.046 |
| — | 14.0 | 26.0 | 0.6 | 0.66 | 1.50 | 1.0 | 1.0 | 0.047 |
| — | 14.0 | 31.0 | 0.6 | 0.35 | 2.8 | 1.8 | 1.9 | 0.059 |
| — | 14.0 | 31.0 | 0.6 | 0.71 | 1.4 | 0.89 | 0.93 | 0.080 |
| — | 16.0 | 28.0 | 0.6 | 0.36 | 2.7 | 1.8 | 1.8 | 0.041 |
| — | 16.0 | 28.0 | 0.6 | 0.37 | 2.60 | 1.7 | 0.040 | 0.040 |
| — | 16.0 | 28.0 | 0.6 | 0.58 | 1.7 | 1.1 | 1.1 | 0.051 |
| — | 16.0 | 28.0 | 0.6 | 0.53 | 1.85 | 1.2 | 1.3 | 0.053 |
| — | 17.0 | 32.0 | 1.0 | 0.33 | 2.9 | 1.9 | 2.0 | 0.068 |
| — | 17.0 | 32.0 | 1.0 | 0.35 | 2.80 | 1.8 | 1.9 | 0.067 |
| — | 17.0 | 32.0 | 1.0 | 0.60 | 1.6 | 1.1 | 1.1 | 0.089 |
| — | 19.0 | 31.0 | 0.6 | 0.32 | 3.1 | 2.0 | 2.1 | 0.050 |
| — | 19.0 | 31.0 | 0.6 | 0.34 | 2.90 | 1.9 | 2.0 | 0.049 |
| — | 19.0 | 31.0 | 0.6 | 0.50 | 1.9 | 1.3 | 1.3 | 0.058 |
| — | 19.0 | 31.0 | 0.6 | 0.46 | 2.10 | 1.4 | 1.4 | 0.060 |
| — | 20.0 | 37.0 | 1.0 | 0.33 | 2.9 | 1.9 | 2.0 | 0.101 |
| — | 20.0 | 37.0 | 1.0 | 0.35 | 2.80 | 1.8 | 1.9 | 0.094 |
| — | 20.0 | 37.0 | 1.0 | 0.51 | 1.9 | 1.2 | 1.3 | 0.116 |
| — | 20.0 | 37.0 | 1.0 | 0.51 | 1.90 | 1.2 | 1.3 | 0.110 |
| — | 21.0 | 36.0 | 0.6 | 0.31 | 3.1 | 2.0 | 2.1 | 0.074 |
| — | 21.0 | 36.0 | 0.6 | 0.33 | 3.00 | 1.9 | 2.0 | 0.073 |
| — | 21.0 | 36.0 | 0.6 | 0.50 | 1.9 | 1.3 | 1.3 | 0.089 |
| — | 21.0 | 36.0 | 0.6 | 0.46 | 2.10 | 1.4 | 1.4 | 0.088 |
| — | 22.0 | 42.0 | 1.0 | 0.32 | 3.1 | 2.0 | 2.1 | 0.13 |
| — | 22.0 | 42.0 | 1.0 | 0.32 | 3.00 | 1.9 | 2.0 | 0.130 |
| — | 22.0 | 42.0 | 1.0 | 0.51 | 1.9 | 1.2 | 1.3 | 0.16 |
| — | 22.0 | 42.0 | 1.0 | 0.53 | 1.90 | 1.2 | 1.3 | 0.160 |

## Bore Diameter 20 – 35 mm




Cylindrical Bore

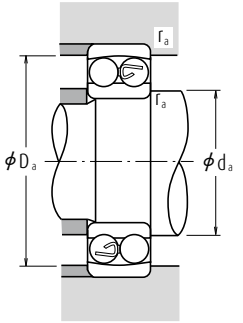



Tapered Bore

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Limiting Speeds (min$^{-1}$) | | Bearing |
|---|---|---|---|---|---|---|---|---|
| d | D | B | r min. | $C_r$ | $C_{0r}$ | Grease | Oil | Cylindrical Bore |
| **20** | 47 | 14 | 1.0 | 10 000 | 2 610 | 14 000 | 17 000 | **1204** |
| | 47 | 14 | 1.0 | 10 000 | 2 650 | 15 000 | 18 000 | **1204TNG** |
| | 47 | 18 | 1.0 | 12 800 | 3 300 | 14 000 | 17 000 | **2204** |
| | 47 | 18 | 1.0 | 14 300 | 3 550 | 14 000 | 17 000 | **2204ETNG** |
| | 52 | 15 | 1.1 | 12 600 | 3 350 | 12 000 | 15 000 | **1304** |
| | 52 | 15 | 1.1 | 12 500 | 3 350 | 13 000 | 16 000 | **1304TNG** |
| | 52 | 21 | 1.1 | 18 500 | 4 700 | 11 000 | 14 000 | **2304** |
| | 52 | 21 | 1.1 | 18 000 | 4 650 | 13 000 | 16 000 | **2304J** |
| **25** | 52 | 15 | 1.0 | 12 200 | 3 300 | 12 000 | 14 000 | **1205** |
| | 52 | 15 | 1.0 | 12 200 | 3 350 | 13 000 | 16 000 | **1205TNG** |
| | 52 | 18 | 1.0 | 12 400 | 3 450 | 12 000 | 14 000 | **2205** |
| | 52 | 18 | 1.0 | 17 000 | 4 400 | 12 000 | 15 000 | **2205ETNG** |
| | 62 | 17 | 1.1 | 18 200 | 5 000 | 10 000 | 13 000 | **1305** |
| | 62 | 17 | 1.1 | 18 000 | 5 000 | 11 000 | 14 000 | **1305TNG** |
| | 62 | 24 | 1.1 | 24 900 | 6 600 | 9 500 | 12 000 | **2305** |
| | 62 | 24 | 1.1 | 24 500 | 6 550 | 10 000 | 13 000 | **2305TNG** |
| **30** | 62 | 16 | 1.0 | 15 800 | 4 650 | 10 000 | 12 000 | **1206** |
| | 62 | 16 | 1.0 | 15 600 | 4 650 | 11 000 | 14 000 | **1206TNG** |
| | 62 | 20 | 1.0 | 15 300 | 4 550 | 10 000 | 12 000 | **2206** |
| | 62 | 20 | 1.0 | 25 500 | 6 950 | 9 500 | 12 000 | **2206ETNG** |
| | 72 | 19 | 1.1 | 21 400 | 6 300 | 8 500 | 11 000 | **1306** |
| | 72 | 19 | 1.1 | 21 200 | 6 300 | 9 000 | 11 000 | **1306TNG** |
| | 72 | 27 | 1.1 | 32 000 | 8 750 | 8 000 | 10 000 | **2306** |
| | 72 | 27 | 1.1 | 31 500 | 8 650 | 8 500 | 10 000 | **2306TNG** |
| **35** | 72 | 17 | 1.1 | 15 900 | 5 100 | 8 500 | 10 000 | **1207** |
| | 72 | 17 | 1.1 | 16 000 | 5 200 | 9 500 | 12 000 | **1207TNG** |
| | 72 | 23 | 1.1 | 21 700 | 6 600 | 8 500 | 10 000 | **2207** |
| | 72 | 23 | 1.1 | 32 000 | 9 000 | 8 000 | 9 500 | **2207ETNG** |
| | 80 | 21 | 1.5 | 25 300 | 7 850 | 7 500 | 9 500 | **1307** |
| | 80 | 21 | 1.5 | 25 000 | 8 000 | 8 000 | 9 500 | **1307TNG** |
| | 80 | 31 | 1.5 | 40 000 | 11 300 | 7 100 | 9 000 | **2307** |
| | 80 | 31 | 1.5 | 39 000 | 11 200 | 7 500 | 9 000 | **2307TNG** |

**Note** (1) The suffix K represents bearings with tapered bores (1 : 12)

**Remark** For the dimensions related to adapters, refer to Page **B376**, **B377** and **B378**.




## Dynamic Equivalent Load $P=XF_r+YF_a$

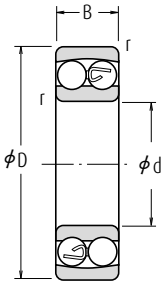
| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | $Y_3$ | 0.65 | $Y_2$ |

## Static Equivalent Load $P_0=F_r+Y_0F_a$

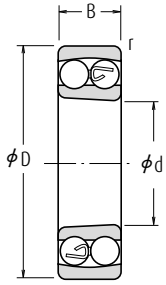
The values of e, $Y_2$ , $Y_3$ , and $Y_0$ are listed in the table below.

| Numbers | Abutment and Fillet Dimensions (mm) | | | Constant | Axial Load Factors | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|
| Tapered Bore(1) | $d_a$ min. | $D_a$ max. | $r_a$ max. | e | $Y_2$ | $Y_3$ | $Y_0$ | approx. |
| **1204 K** | 25.0 | 42.0 | 1.0 | 0.29 | 3.4 | 2.2 | 2.3 | 0.12 |
| **1204KTNG** | 25.0 | 42.0 | 1.0 | 0.28 | 3.50 | 2.2 | 2.3 | 0.120 |
| **2204 K** | 25.0 | 42.0 | 1.0 | 0.47 | 2.1 | 1.3 | 1.4 | 0.142 |
| **2204EKTNG** | 25.0 | 42.0 | 1.0 | 0.44 | 2.20 | 1.5 | 1.5 | 0.140 |
| **1304 K** | 26.5 | 45.5 | 1.0 | 0.29 | 3.4 | 2.2 | 2.3 | 0.164 |
| **1304KTNG** | 26.5 | 45.5 | 1.0 | 0.29 | 3.30 | 2.2 | 2.3 | 0.160 |
| **2304 K** | 26.5 | 45.5 | 1.0 | 0.50 | 1.9 | 1.2 | 1.3 | 0.210 |
| **2304KJ** | 26.5 | 45.5 | 1.0 | 0.51 | 1.90 | 1.2 | 1.3 | 0.210 |
| **1205 K** | 30.0 | 47.0 | 1.0 | 0.28 | 3.5 | 2.3 | 2.4 | 0.14 |
| **1205KTNG** | 30.0 | 47.0 | 1.0 | 0.27 | 3.70 | 2.4 | 2.5 | 0.140 |
| **2205 K** | 30.0 | 47.0 | 1.0 | 0.41 | 2.4 | 1.5 | 1.6 | 0.16 |
| **2205EKTNG** | 30.0 | 47.0 | 1.0 | 0.35 | 2.80 | 1.8 | 1.9 | 0.160 |
| **1305 K** | 31.5 | 55.5 | 1.0 | 0.28 | 3.5 | 2.3 | 2.4 | 0.261 |
| **1305KTNG** | 31.5 | 55.5 | 1.0 | 0.28 | 3.50 | 2.3 | 2.4 | 0.260 |
| **2305 K** | 31.5 | 55.5 | 1.0 | 0.47 | 2.1 | 1.4 | 1.4 | 0.340 |
| **2305KTNG** | 31.5 | 55.5 | 1.0 | 0.48 | 2.00 | 1.3 | 1.4 | 0.340 |
| **1206 K** | 35.0 | 57.0 | 1.0 | 0.25 | 3.9 | 2.5 | 2.6 | 0.22 |
| **1206KTNG** | 35.0 | 57.0 | 1.0 | 0.25 | 3.90 | 2.5 | 2.7 | 0.220 |
| **2206 K** | 35.0 | 57.0 | 1.0 | 0.38 | 2.5 | 1.6 | 1.7 | 0.262 |
| **2206EKTNG** | 35.0 | 57.0 | 1.0 | 0.30 | 3.30 | 2.1 | 2.2 | 0.260 |
| **1306 K** | 36.5 | 65.5 | 1.0 | 0.26 | 3.7 | 2.4 | 2.5 | 0.391 |
| **1306KTNG** | 36.5 | 65.5 | 1.0 | 0.26 | 3.70 | 2.4 | 2.5 | 0.390 |
| **2306 K** | 36.5 | 65.5 | 1.0 | 0.44 | 2.2 | 1.4 | 1.5 | 0.51 |
| **2306KTNG** | 36.5 | 65.5 | 1.0 | 0.45 | 2.20 | 1.4 | 1.5 | 0.500 |
| **1207 K** | 41.5 | 65.5 | 1.0 | 0.23 | 4.2 | 2.7 | 2.8 | 0.33 |
| **1207KTNG** | 41.5 | 65.5 | 1.0 | 0.22 | 4.30 | 2.8 | 2.9 | 0.320 |
| **2207 K** | 41.5 | 65.5 | 1.0 | 0.37 | 2.6 | 1.7 | 1.8 | 0.403 |
| **2207EKTNG** | 41.5 | 65.5 | 1.0 | 0.30 | 3.30 | 2.1 | 2.2 | 0.400 |
| **1307 K** | 43.0 | 72.0 | 1.5 | 0.26 | 3.8 | 2.5 | 2.6 | 0.52 |
| **1307KTNG** | 43.0 | 72.0 | 1.5 | 0.26 | 3.80 | 2.5 | 2.6 | 0.510 |
| **2307 K** | 43.0 | 72.0 | 1.5 | 0.46 | 2.1 | 1.4 | 1.4 | 0.687 |
| **2307KTNG** | 43.0 | 72.0 | 1.5 | 0.47 | 2.10 | 1.4 | 1.4 | 0.680 |

## Bore Diameter 40 – 55 mm




Cylindrical Bore



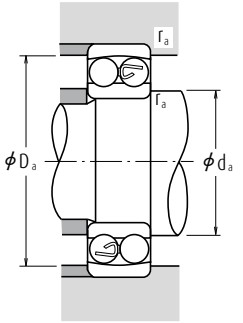

Tapered Bore

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Limiting Speeds ($min^{-1}$) | | Bearing |
|---|---|---|---|---|---|---|---|---|
| d | D | B | r min. | $C_r$ | $C_{0r}$ | Grease | Oil | Cylindrical Bore |
| **40** | 80 | 18 | 1.1 | 19 300 | 6 500 | 7 500 | 9 000 | **1208** |
| | 80 | 18 | 1.1 | 19 300 | 6 550 | 8 500 | 10 000 | **1208TNG** |
| | 80 | 23 | 1.1 | 22 400 | 7 350 | 7 500 | 9 000 | **2208** |
| | 80 | 23 | 1.1 | 31 500 | 9 500 | 7 500 | 9 000 | **2208ETNG** |
| | 90 | 23 | 1.5 | 29 800 | 9 700 | 6 700 | 8 500 | **1308** |
| | 90 | 23 | 1.5 | 29 000 | 9 650 | 7 000 | 8 500 | **1308TNG** |
| | 90 | 33 | 1.5 | 45 500 | 13 500 | 6 300 | 8 000 | **2308** |
| | 90 | 33 | 1.5 | 45 000 | 13 400 | 6 700 | 8 000 | **2308TNG** |
| **45** | 85 | 19 | 1.1 | 22 000 | 7 350 | 7 100 | 8 500 | **1209** |
| | 85 | 19 | 1.1 | 22 000 | 7 350 | 7 500 | 9 000 | **1209TNG** |
| | 85 | 23 | 1.1 | 23 300 | 8 150 | 7 100 | 8 500 | **2209** |
| | 85 | 23 | 1.1 | 28 000 | 9 000 | 7 000 | 8 500 | **2209ETNG** |
| | 100 | 25 | 1.5 | 38 500 | 12 700 | 6 000 | 7 500 | **1309** |
| | 100 | 25 | 1.5 | 38 000 | 12 900 | 6 300 | 7 500 | **1309TNG** |
| | 100 | 36 | 1.5 | 55 000 | 16 700 | 5 600 | 7 100 | **2309** |
| | 100 | 36 | 1.5 | 54 000 | 16 300 | 6 000 | 7 000 | **2309TNG** |
| **50** | 90 | 20 | 1.1 | 22 800 | 8 100 | 6 300 | 8 000 | **1210** |
| | 90 | 20 | 1.1 | 22 800 | 8 150 | 7 000 | 8 500 | **1210TNG** |
| | 90 | 23 | 1.1 | 23 300 | 8 450 | 6 300 | 8 000 | **2210** |
| | 90 | 23 | 1.1 | 28 000 | 9 500 | 6 700 | 8 000 | **2210ETNG** |
| | 110 | 27 | 2.0 | 43 500 | 14 100 | 5 600 | 6 700 | **1310** |
| | 110 | 27 | 2.0 | 41 500 | 14 300 | 5 600 | 6 700 | **1310TNG** |
| | 110 | 40 | 2.0 | 65 000 | 20 200 | 5 000 | 6 300 | **2310** |
| | 110 | 40 | 2.0 | 64 000 | 20 000 | 5 300 | 6 300 | **2310TNG** |
| **55** | 100 | 21 | 1.5 | 26 900 | 10 000 | 6 000 | 7 100 | **1211** |
| | 100 | 21 | 1.5 | 27 000 | 10 000 | 6 300 | 7 500 | **1211TNG** |
| | 100 | 25 | 1.5 | 26 700 | 9 900 | 6 000 | 7 100 | **2211** |
| | 100 | 25 | 1.5 | 39 000 | 12 700 | 5 600 | 6 700 | **2211ETNG** |
| | 120 | 29 | 2.0 | 51 500 | 17 900 | 5 000 | 6 300 | **1311** |
| | 120 | 29 | 2.0 | 51 000 | 18 000 | 5 000 | 6 000 | **1311TNG** |
| | 120 | 43 | 2.0 | 76 500 | 24 000 | 4 800 | 6 000 | **2311** |
| | 120 | 43 | 2.0 | 75 000 | 23 600 | 4 800 | 5 600 | **2311TNG** |

**Notes** (1) The suffix K represents bearings with tapered bores (1 : 12)

(*) The balls of the bearings marked * protrude slightly from the bearing face. The protrusion amounts are shown on Page **B120**.

**Remark** For the dimensions related to adapters, refer to Pages **B378** and **B379**.




## Dynamic Equivalent Load $P=XF_r+YF_a$

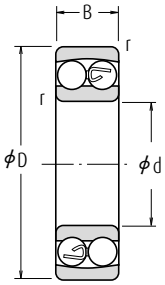
| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | $Y_3$ | 0.65 | $Y_2$ |

## Static Equivalent Load $P_0=F_r+Y_0F_a$

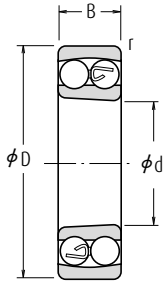
The values of e, $Y_2$ , $Y_3$ , and $Y_0$ are listed in the table below.

| Numbers | Abutment and Fillet Dimensions (mm) | | | Constant | Axial Load Factors | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|
| Tapered Bore(1) | $d_a$ min. | $D_a$ max. | $r_a$ max. | e | $Y_2$ | $Y_3$ | $Y_0$ | approx. |
| **1208 K** | 46.5 | 73.5 | 1.0 | 0.22 | 4.3 | 2.8 | 2.9 | 0.42 |
| **1208KTNG** | 46.5 | 73.5 | 1.0 | 0.22 | 4.5 | 2.9 | 3.0 | 0.420 |
| **2208 K** | 46.5 | 73.5 | 1.0 | 0.33 | 3.0 | 1.9 | 2.0 | 0.506 |
| **2208EKTNG** | 46.5 | 73.5 | 1.0 | 0.26 | 3.8 | 2.4 | 2.5 | 0.510 |
| **1308 K** | 48.0 | 82.0 | 1.5 | 0.24 | 4.0 | 2.6 | 2.7 | 0.727 |
| **1308KTNG** | 48.0 | 82.0 | 1.5 | 0.25 | 3.9 | 2.5 | 2.6 | 0.720 |
| **2308 K** | 48.0 | 82.0 | 1.5 | 0.43 | 2.3 | 1.5 | 1.5 | 0.940 |
| **2308KTNG** | 48.0 | 82.0 | 1.5 | 0.43 | 2.3 | 1.5 | 1.5 | 0.93 |
| **1209 K** | 51.5 | 78.5 | 1.0 | 0.21 | 4.7 | 3.0 | 3.1 | 0.47 |
| **1209KTNG** | 51.5 | 78.5 | 1.0 | 0.21 | 4.7 | 3.0 | 3.2 | 0.47 |
| **2209 K** | 51.5 | 78.5 | 1.0 | 0.30 | 3.2 | 2.1 | 2.2 | 0.556 |
| **2209EKTNG** | 51.5 | 78.5 | 1.0 | 0.26 | 3.8 | 2.4 | 2.5 | 0.55 |
| **1309 K** | 53.0 | 92.0 | 1.5 | 0.25 | 4.0 | 2.6 | 2.7 | 0.971 |
| **1309KTNG** | 53.0 | 92.0 | 1.5 | 0.25 | 3.9 | 2.5 | 2.6 | 0.96 |
| **2309 K** | 53.0 | 92.0 | 1.5 | 0.41 | 2.4 | 1.5 | 1.6 | 1.3 |
| **2309KTNG** | 53.0 | 92.0 | 1.5 | 0.43 | 2.3 | 1.5 | 1.6 | 1.25 |
| **1210 K** | 56.5 | 83.5 | 1.0 | 0.21 | 4.7 | 3.1 | 3.2 | 0.535 |
| **1210KTNG** | 56.5 | 83.5 | 1.0 | 0.19 | 4.9 | 3.2 | 3.3 | 0.53 |
| **2210 K** | 56.5 | 83.5 | 1.0 | 0.28 | 3.4 | 2.2 | 2.3 | 0.598 |
| **2210EKTNG** | 56.5 | 83.5 | 1.0 | 0.22 | 4.1 | 2.6 | 3.7 | 0.59 |
| **1310 K** | 59.0 | 101.0 | 2.0 | 0.23 | 4.2 | 2.7 | 2.8 | 1.23 |
| **1310KTNG** | 59.0 | 101.0 | 2.0 | 0.24 | 4.0 | 2.6 | 2.7 | 1.20 |
| **2310 K** | 59.0 | 101.0 | 2.0 | 0.42 | 2.3 | 1.5 | 1.6 | 1.66 |
| **2310KTNG** | 59.0 | 101.0 | 2.0 | 0.43 | 2.3 | 1.5 | 1.5 | 1.65 |
| **1211 K** | 63.0 | 92.0 | 1.5 | 0.20 | 4.9 | 3.2 | 3.3 | 0.708 |
| **1211KTNG** | 63.0 | 92.0 | 1.5 | 0.19 | 5.1 | 3.3 | 3.5 | 0.71 |
| **2211 K** | 63.0 | 92.0 | 1.5 | 0.28 | 3.5 | 2.3 | 2.4 | 0.807 |
| **2211EKTNG** | 63.0 | 92.0 | 1.5 | 0.22 | 4.5 | 2.9 | 2.1 | 0.81 |
| **1311 K** | 64.0 | 111.0 | 2.0 | 0.23 | 4.2 | 2.7 | 2.8 | 1.6 |
| **1311KTNG** | 64.0 | 111.0 | 2.0 | 0.24 | 4.1 | 2.7 | 2.8 | 1.60 |
| **2311 K** | 64.0 | 111.0 | 2.0 | 0.41 | 2.4 | 1.5 | 1.6 | 2.12 |
| **2311KTNG** | 64.0 | 111.0 | 2.0 | 0.42 | 2.3 | 1.5 | 1.6 | 2.10 |

## Bore Diameter 60 – 75 mm




Cylindrical Bore



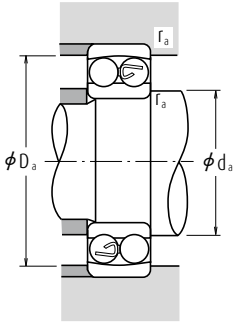

Tapered Bore

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Limiting Speeds (min$^{-1}$) | | Bearing |
|---|---|---|---|---|---|---|---|---|
| d | D | B | r min. | $C_r$ | $C_{0r}$ | Grease | Oil | Cylindrical Bore |
| **60** | 110 | 22 | 1.5 | 30 500 | 11 500 | 5 300 | 6 300 | **1212** |
| | 110 | 22 | 1.5 | 30 000 | 11 600 | 5 600 | 6 700 | **1212TNG** |
| | 110 | 28 | 1.5 | 34 000 | 12 600 | 5 300 | 6 300 | **2212** |
| | 110 | 28 | 1.5 | 47 500 | 16 600 | 5 300 | 6 300 | **2212ETNG** |
| | 130 | 31 | 2.1 | 57 500 | 20 800 | 4 500 | 5 600 | **1312** |
| | 130 | 31 | 2.0 | 57 500 | 20 800 | 4 800 | 5 600 | **1312TNG** |
| | 130 | 46 | 2.1 | 88 500 | 28 300 | 4 300 | 5 300 | **2312** |
| | 130 | 46 | 2.0 | 88 500 | 28 300 | 4 300 | 5 300 | **2312TNG** |
| **65** | 120 | 23 | 1.5 | 31 000 | 12 500 | 4 800 | 6 000 | **1213** |
| | 120 | 23 | 1.5 | 31 000 | 12 500 | 5 300 | 6 300 | **1213TNG** |
| | 120 | 31 | 1.5 | 43 500 | 16 400 | 4 800 | 6 000 | **2213** |
| | 120 | 31 | 1.5 | 57 000 | 19 300 | 4 500 | 5 300 | **2213ETNG** |
| | 140 | 33 | 2.1 | 62 500 | 22 900 | 4 300 | 5 300 | **1313** |
| | 140 | 33 | 2.1 | 62 500 | 22 900 | 4 300 | 5 300 | **1313J** |
| | 140 | 48 | 2.1 | 97 000 | 32 500 | 3 800 | 4 800 | **2313** |
| | 140 | 48 | 2.1 | 96 500 | 32 500 | 4 000 | 4 800 | **2313J** |
| **70** | 125 | 24 | 1.5 | 35 000 | 13 800 | 4 800 | 5 600 | **1214** |
| | 125 | 24 | 1.5 | 34 500 | 13 700 | 5 000 | 6 000 | **1214TNG** |
| | 125 | 31 | 1.5 | 44 000 | 17 100 | 4 500 | 5 600 | **2214** |
| | 125 | 31 | 1.5 | 44 000 | 17 100 | 4 500 | 5 600 | **2214J** |
| | 150 | 35 | 2.1 | 75 000 | 27 700 | 4 000 | 5 000 | **1314** |
| | 150 | 35 | 2.1 | 67 500 | 25 100 | 4 000 | 5 000 | **1314J** |
| | 150 | 51 | 2.1 | 111 000 | 37 500 | 3 600 | 4 500 | **2314** |
| | 150 | 51 | 2.1 | 111 000 | 37 500 | 3 600 | 4 300 | **2314J** |
| **75** | 130 | 25 | 1.5 | 39 000 | 15 700 | 4 300 | 5 300 | **1215** |
| | 130 | 25 | 1.5 | 39 000 | 15 600 | 4 800 | 5 600 | **1215TNG** |
| | 130 | 31 | 1.5 | 44 500 | 17 800 | 4 300 | 5 300 | **2215** |
| | 130 | 31 | 1.5 | 44 500 | 17 800 | 4 300 | 5 300 | **2215J** |
| | 160 | 37 | 2.1 | 80 000 | 30 000 | 3 800 | 4 500 | **1315** |
| | 160 | 37 | 2.1 | 80 000 | 30 000 | 3 800 | 4 500 | **1315J** |
| | 160 | 55 | 2.1 | 125 000 | 43 000 | 3 400 | 4 300 | **2315** |
| | 160 | 55 | 2.1 | 125 000 | 43 000 | 3 400 | 4 300 | **2315J** |

**Notes** (1) The suffix K represents bearings with tapered bores (1 : 12)

(*) The balls of the bearings marked * protrude slightly from the bearing face. The protrusion amounts are shown on Page **B120**.

**Remark** For the dimensions related to adapters, refer to Pages **B378** and **B379**.




## Dynamic Equivalent Load $P=XF_r+YF_a$

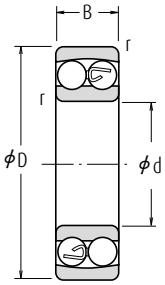
| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | $Y_3$ | 0.65 | $Y_2$ |

## Static Equivalent Load $P_0=F_r+Y_0F_a$

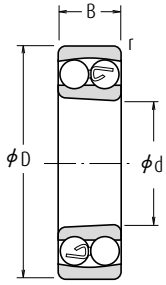
The values of e, $Y_2$ , $Y_3$ , and $Y_0$ are listed in the table below.

| Numbers | Abutment and Fillet Dimensions (mm) | | | Constant | Axial Load Factors | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|
| Tapered Bore(1) | $d_a$ min. | $D_a$ max. | $r_a$ max. | e | $Y_2$ | $Y_3$ | $Y_0$ | approx. |
| **1212 K** | 68.0 | 102.0 | 1.5 | 0.18 | 5.3 | 3.4 | 3.6 | 0.91 |
| **1212KTNG** | 68.5 | 101.5 | 1.5 | 0.18 | 5.4 | 3.5 | 3.6 | 0.90 |
| **2212 K** | 68.0 | 102.0 | 1.5 | 0.28 | 3.5 | 2.3 | 2.4 | 1.1 |
| **2212EKTNG** | 68.5 | 101.5 | 1.5 | 0.23 | 4.2 | 2.7 | 2.8 | 1.10 |
| **1312 K** | 71.0 | 119.0 | 2.0 | 0.23 | 4.3 | 2.8 | 2.9 | 2.0 |
| **1312KJ** | 72.0 | 118.0 | 2.0 | 0.23 | 4.3 | 2.8 | 2.9 | 1.95 |
| **2312 K** | 71.0 | 119.0 | 2.0 | 0.40 | 2.4 | 1.6 | 1.6 | 2.63 |
| **2312KJ** | 72.0 | 118.0 | 2.0 | 0.40 | 2.4 | 1.6 | 1.7 | 2.60 |
| **1213 K** | 73.0 | 112.0 | 1.5 | 0.17 | 5.7 | 3.7 | 3.8 | 1.16 |
| **1213KTNG** | 73.0 | 112.0 | 1.5 | 0.18 | 5.5 | 3.6 | 3.7 | 1.15 |
| **2213 K** | 73.0 | 112.0 | 1.5 | 0.28 | 3.5 | 2.3 | 2.4 | 1.5 |
| **2213EKTNG** | 73.0 | 112.0 | 1.5 | 0.23 | 4.3 | 2.8 | 2.9 | 1.45 |
| **1313 K** | 76.0 | 129.0 | 2.0 | 0.23 | 4.2 | 2.7 | 2.9 | 2.47 |
| **1313KTNG** | 76.0 | 128.0 | 2.0 | 0.23 | 4.3 | 2.8 | 2.9 | 2.45 |
| **2313 K** | 76.0 | 129.0 | 2.0 | 0.39 | 2.5 | 1.6 | 1.7 | 3.3 |
| **2313KTNG** | 76.0 | 128.0 | 2.0 | 0.39 | 2.5 | 1.6 | 1.7 | 3.25 |
| — | 78.0 | 117.0 | 1.5 | 0.18 | 5.3 | 3.4 | 3.6 | 1.3 |
| — | 78.0 | 116.5 | 1.5 | 0.19 | 5.1 | 3.3 | 3.5 | 1.25 |
| — | 78.0 | 117.0 | 1.5 | 0.26 | 3.7 | 2.4 | 2.5 | 1.55 |
| — | 78.0 | 116.5 | 1.5 | 0.26 | 3.7 | 2.4 | 2.5 | 1.50 |
| — | 81.0 | 139.0 | 2.0 | 0.22 | 4.4 | 2.8 | 3.0 | 3.03 |
| — | 81.0 | 138.0 | 2.0 | 0.22 | 4.4 | 2.8 | 3.0 | 3.00 |
| — | 81.0 | 139.0 | 2.0 | 0.38 | 2.6 | 1.7 | 1.8 | 4.0 |
| — | 81.0 | 138.0 | 2.0 | 0.38 | 2.6 | 1.7 | 1.8 | 4.25 |
| **1215 K** | 83.0 | 122.0 | 1.5 | 0.17 | 5.6 | 3.6 | 3.8 | 1.36 |
| **1215KTNG** | 83.5 | 121.5 | 1.5 | 0.17 | 5.6 | 3.6 | 3.8 | 1.35 |
| **2215 K** | 83.0 | 122.0 | 1.5 | 0.25 | 3.9 | 2.5 | 2.6 | 1.6 |
| **2215KJ** | 83.5 | 121.5 | 1.5 | 0.25 | 3.9 | 2.5 | 2.6 | 1.60 |
| **1315 K** | 86.0 | 149.0 | 2.0 | 0.22 | 4.4 | 2.8 | 2.9 | 3.63 |
| **1315KJ** | 87.0 | 148.0 | 2.0 | 0.22 | 4.4 | 2.8 | 3.0 | 3.55 |
| **2315 K** | 86.0 | 149.0 | 2.0 | 0.38 | 2.5 | 1.6 | 1.7 | 4.84 |
| **2315KJ** | 87.0 | 148.0 | 2.0 | 0.38 | 2.6 | 1.6 | 1.7 | 5.15 |

## Bore Diameter 80 – 110 mm




Cylindrical Bore

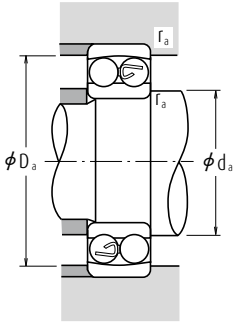



Tapered Bore

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Limiting Speeds (min$^{-1}$) | | Bearing |
|---|---|---|---|---|---|---|---|---|
| d | D | B | r min. | $C_r$ | $C_{0r}$ | Grease | Oil | Cylindrical Bore |
| **80** | 140 | 26 | 2.0 | 40 000 | 17 000 | 4 000 | 5 000 | **1216** |
| | 140 | 33 | 2.0 | 49 000 | 19 900 | 4 000 | 5 000 | **2216** |
| | 170 | 39 | 2.1 | 89 000 | 33 000 | 3 600 | 4 300 | **1316** |
| | 170 | 58 | 2.1 | 130 000 | 45 000 | 3 200 | 4 000 | * **2316** |
| **85** | 150 | 28 | 2.0 | 49 500 | 20 800 | 3 800 | 4 500 | **1217** |
| | 150 | 36 | 2.0 | 58 500 | 23 600 | 3 800 | 4 800 | **2217** |
| | 180 | 41 | 3.0 | 98 500 | 38 000 | 3 400 | 4 000 | **1317** |
| | 180 | 60 | 3.0 | 142 000 | 51 500 | 3 000 | 3 800 | **2317** |
| **90** | 160 | 30 | 2.0 | 57 500 | 23 500 | 3 600 | 4 300 | **1218** |
| | 160 | 40 | 2.0 | 70 500 | 28 700 | 3 600 | 4 300 | **2218** |
| | 190 | 43 | 3.0 | 117 000 | 44 500 | 3 200 | 3 800 | * **1318** |
| | 190 | 64 | 3.0 | 154 000 | 57 500 | 2 800 | 3 600 | **2318** |
| **95** | 170 | 32 | 2.1 | 64 000 | 27 100 | 3 400 | 4 000 | **1219** |
| | 170 | 43 | 2.1 | 84 000 | 34 500 | 3 400 | 4 000 | **2219** |
| | 200 | 45 | 3.0 | 129 000 | 51 000 | 3 000 | 3 600 | * **1319** |
| | 200 | 67 | 3.0 | 161 000 | 64 500 | 2 800 | 3 400 | * **2319** |
| **100** | 180 | 34 | 2.1 | 69 500 | 29 700 | 3 200 | 3 800 | **1220** |
| | 180 | 46 | 2.1 | 94 500 | 38 500 | 3 200 | 3 800 | **2220** |
| | 215 | 47 | 3.0 | 140 000 | 57 500 | 2 800 | 3 400 | * **1320** |
| | 215 | 73 | 3.0 | 187 000 | 79 000 | 2 400 | 3 200 | * **2320** |
| **105** | 190 | 36 | 2.1 | 75 000 | 32 500 | 3 000 | 3 600 | **1221** |
| | 190 | 50 | 2.1 | 109 000 | 45 000 | 3 000 | 3 600 | **2221** |
| | 225 | 49 | 3.0 | 154 000 | 64 500 | 2 600 | 3 200 | * **1321** |
| | 225 | 77 | 3.0 | 200 000 | 87 000 | 2 400 | 3 000 | * **2321** |
| **110** | 200 | 38 | 2.1 | 87 000 | 38 500 | 2 800 | 3 400 | **1222** |
| | 200 | 53 | 2.1 | 122 000 | 51 500 | 2 800 | 3 400 | * **2222** |
| | 240 | 50 | 3.0 | 161 000 | 72 000 | 2 400 | 3 000 | * **1322** |
| | 240 | 80 | 3.0 | 211 000 | 94 500 | 2 200 | 2 800 | * **2322** |

**Notes** (1) The suffix K represents bearings with tapered bores (1 : 12)
(*) The balls of the bearings marked * protrude slightly from the bearing face. The protrusion amounts are shown on Page **B120**.

**Remark** For the dimensions related to adapters, refer to Pages **B378** and **B379**.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | $Y_3$ | 0.65 | $Y_2$ |

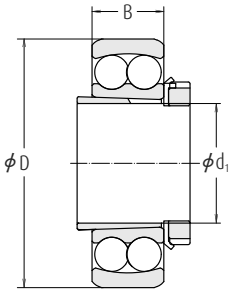
## Static Equivalent Load $P_0=F_r+Y_0F_a$

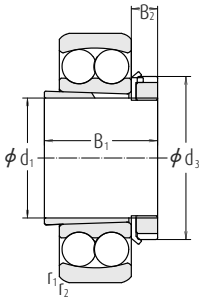
The values of e, $Y_2$ , $Y_3$ , and $Y_0$ are listed in the table below.

| Numbers | Abutment and Fillet Dimensions (mm) | | | Constant | Axial Load Factors | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|
| Tapered Bore(1) | $d_a$ min. | $D_a$ max. | $r_a$ max. | e | $Y_2$ | $Y_3$ | $Y_0$ | approx. |
| **1216 K** | 89 | 131 | 2.0 | 0.16 | 6.0 | 3.9 | 4.1 | 1.68 |
| **2216 K** | 89 | 131 | 2.0 | 0.25 | 3.9 | 2.5 | 2.7 | 1.97 |
| **1316 K** | 91 | 159 | 2.0 | 0.22 | 4.5 | 2.9 | 3.1 | 4.24 |
| * **2316 K** | 91 | 159 | 2.0 | 0.39 | 2.5 | 1.6 | 1.7 | 5.75 |
| **1217 K** | 94 | 141 | 2.0 | 0.17 | 5.7 | 3.7 | 3.8 | 2.1 |
| **2217 K** | 94 | 141 | 2.0 | 0.25 | 3.9 | 2.5 | 2.6 | 2.56 |
| **1317 K** | 98 | 167 | 2.5 | 0.21 | 4.6 | 2.9 | 3.1 | 5.03 |
| **2317 K** | 98 | 167 | 2.5 | 0.37 | 2.6 | 1.7 | 1.8 | 6.68 |
| **1218 K** | 99 | 151 | 2.0 | 0.17 | 5.8 | 3.8 | 3.9 | 2.56 |
| **2218 K** | 99 | 151 | 2.0 | 0.27 | 3.7 | 2.4 | 2.5 | 3.22 |
| * **1318 K** | 103 | 177 | 2.5 | 0.22 | 4.3 | 2.8 | 2.9 | 5.83 |
| **2318 K** | 103 | 177 | 2.5 | 0.38 | 2.6 | 1.7 | 1.7 | 7.87 |
| **1219 K** | 106 | 159 | 2.0 | 0.17 | 5.8 | 3.7 | 3.9 | 3.12 |
| **2219 K** | 106 | 159 | 2.0 | 0.27 | 3.7 | 2.4 | 2.5 | 3.96 |
| * **1319 K** | 108 | 187 | 2.5 | 0.23 | 4.3 | 2.8 | 2.9 | 6.79 |
| * **2319 K** | 108 | 187 | 2.5 | 0.38 | 2.6 | 1.7 | 1.8 | 9.09 |
| **1220 K** | 111 | 169 | 2.0 | 0.17 | 5.6 | 3.6 | 3.8 | 3.82 |
| **2220 K** | 111 | 169 | 2.0 | 0.27 | 3.7 | 2.4 | 2.5 | 4.71 |
| * **1320 K** | 113 | 202 | 2.5 | 0.24 | 4.1 | 2.7 | 2.8 | 8.4 |
| * **2320 K** | 113 | 202 | 2.5 | 0.38 | 2.6 | 1.7 | 1.8 | 11.5 |
| — | 116 | 179 | 2.0 | 0.18 | 5.5 | 3.6 | 3.7 | 4.43 |
| — | 116 | 179 | 2.0 | 0.28 | 3.5 | 2.3 | 2.4 | 5.73 |
| — | 118 | 212 | 2.5 | 0.23 | 4.2 | 2.7 | 2.9 | 9.58 |
| — | 118 | 212 | 2.5 | 0.38 | 2.6 | 1.7 | 1.7 | 14.5 |
| **1222 K** | 121 | 189 | 2.0 | 0.17 | 5.7 | 3.7 | 3.9 | 5.21 |
| * **2222 K** | 121 | 189 | 2.0 | 0.28 | 3.5 | 2.2 | 2.3 | 6.75 |
| * **1322 K** | 123 | 227 | 2.5 | 0.22 | 4.4 | 2.8 | 3.0 | 11.5 |
| * **2322 K** | 123 | 227 | 2.5 | 0.37 | 2.6 | 1.7 | 1.8 | 17.5 |

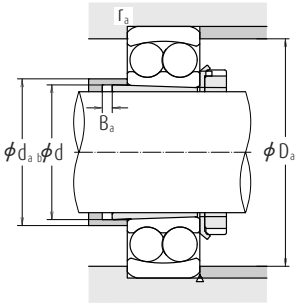
# Self-Aligning Ball Bearings

## With adapter sleeve | Shaft 17–65 mm



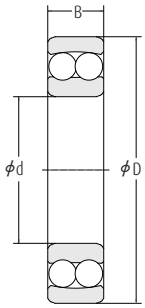




| Dimensions | | | | Load ratings | | Speed limits | | Abbreviation for | |
|---|---|---|---|---|---|---|---|---|---|
| $d_1$ Shaft | D | B | $r_{1,2}$ min. | dyn. C | stat. $C_0$ | Grease | Oil | Bearing | Sleeve |
| | mm | | | kN | | ($min^{-1}$) | | | |
| **17** | 47 | 14 | 1.0 | 10.00 | 2.65 | 15 000 | 18 000 | 1204KTNG | H204 |
| | 47 | 18 | 1.0 | 14.30 | 3.55 | 14 000 | 17 000 | 2204EKTNG | H304 |
| | 52 | 15 | 1.1 | 12.50 | 3.35 | 13 000 | 16 000 | 1304KTNG | H304 |
| | 52 | 21 | 1.1 | 18.00 | 4.65 | 13 000 | 16 000 | 2304KJ | H2304 |
| **20** | 52 | 15 | 1.0 | 12.20 | 3.35 | 13 000 | 16 000 | 1205KTNG | H205 |
| | 52 | 18 | 1.0 | 17.00 | 4.40 | 12 000 | 15 000 | 2205EKTNG | H305 |
| | 62 | 17 | 1.1 | 18.00 | 5.00 | 11 000 | 14 000 | 1305KTNG | H305 |
| | 62 | 24 | 1.1 | 24.50 | 6.55 | 10 000 | 13 000 | 2305KTNG | H2305 |
| **25** | 62 | 16 | 1.0 | 15.60 | 4.65 | 11 000 | 14 000 | 1206KTNG | H206 |
| | 62 | 20 | 1.0 | 25.50 | 6.95 | 9 500 | 12 000 | 2206EKTNG | H306 |
| | 72 | 19 | 1.1 | 21.20 | 6.30 | 9 000 | 11 000 | 1306KTNG | H306 |
| | 72 | 27 | 1.1 | 31.50 | 8.65 | 8 500 | 10 000 | 2306KTNG | H2306 |
| **30** | 72 | 17 | 1.1 | 16.00 | 5.20 | 9 500 | 12 000 | 1207KTNG | H207 |
| | 72 | 23 | 1.1 | 32.00 | 9.00 | 8 000 | 9 500 | 2207EKTNG | H307 |
| | 80 | 21 | 1.5 | 25.00 | 8.00 | 8 000 | 9 500 | 1307KTNG | H307 |
| | 80 | 31 | 1.5 | 39.00 | 11.20 | 7 500 | 9 000 | 2307KTNG | H2307 |
| **35** | 80 | 18 | 1.1 | 19.30 | 6.55 | 8 500 | 10 000 | 1208KTNG | H208 |
| | 80 | 23 | 1.1 | 31.50 | 9.50 | 7 500 | 9 000 | 2208EKTNG | H308 |
| | 90 | 23 | 1.5 | 29.00 | 9.65 | 7 000 | 8 500 | 1308KTNG | H308 |
| | 90 | 33 | 1.5 | 45.00 | 13.40 | 6 700 | 8 000 | 2308KTNG | H2308 |
| **40** | 85 | 19 | 1.1 | 22.00 | 7.35 | 7 500 | 9 000 | 1209KTNG | H209 |
| | 85 | 23 | 1.1 | 28.00 | 9.00 | 7 000 | 8 500 | 2209EKTNG | H309 |
| | 100 | 25 | 1.5 | 38.00 | 12.90 | 6 300 | 7 500 | 1309KTNG | H309 |
| | 100 | 36 | 1.5 | 54.00 | 16.30 | 6 000 | 7 000 | 2309KTNG | H2309 |
| **45** | 90 | 20 | 1.1 | 22.90 | 8.15 | 7 000 | 8 500 | 1210KTNG | H210 |
| | 90 | 23 | 1.1 | 28.00 | 9.50 | 6 700 | 8 000 | 2210EKTNG | H310 |
| | 110 | 27 | 2.0 | 41.50 | 14.30 | 5 600 | 6 700 | 1310KTNG | H310 |
| | 110 | 40 | 2.0 | 64.00 | 20.00 | 5 300 | 6 300 | 2310KTNG | H2310 |
| **50** | 100 | 21 | 1.5 | 27.00 | 10.00 | 6 300 | 7 500 | 1211KTNG | H211 |
| | 100 | 25 | 1.5 | 39.00 | 12.70 | 5 600 | 6 700 | 2211EKTNG | H311 |
| | 120 | 29 | 2.0 | 51.00 | 18.00 | 5 000 | 6 000 | 1311KTNG | H311 |
| | 120 | 43 | 2.0 | 75.00 | 23.60 | 4 800 | 5 600 | 2311KTNG | H2311 |
| **55** | 110 | 22 | 1.5 | 30.00 | 11.60 | 5 600 | 6 700 | 1212KTNG | H212 |
| | 110 | 28 | 1.5 | 47.50 | 16.60 | 5 300 | 6 300 | 2212EKTNG | H312 |
| | 130 | 31 | 2.0 | 57.50 | 20.80 | 4 800 | 5 600 | 1312KJ | H312 |
| | 130 | 46 | 2.0 | 88.50 | 28.30 | 4 300 | 5 300 | 2312KJ | H2312 |
| **60** | 120 | 23 | 1.5 | 31.00 | 12.50 | 5 300 | 6 300 | 1213KTNG | H213 |
| | 120 | 31 | 1.5 | 57.00 | 19.30 | 4 500 | 5 300 | 2213EKTNG | H313 |
| | 140 | 33 | 2.1 | 62.50 | 22.90 | 4 300 | 5 300 | 1313KJ | H313 |
| | 140 | 48 | 2.1 | 96.50 | 32.50 | 4 000 | 4 800 | 2313KJ | H2313 |
| **65** | 130 | 25 | 1.5 | 39.00 | 15.60 | 4 800 | 5 600 | 1215KTNG | H215 |
| | 130 | 31 | 1.5 | 44.50 | 17.80 | 4 300 | 5 300 | 2215KJ | H315 |
| | 160 | 37 | 2.1 | 80.00 | 30.00 | 3 800 | 4 500 | 1315KJ | H315 |
| | 160 | 55 | 2.1 | 125.00 | 43.00 | 3 400 | 4 300 | 2315KJ | H2315 |




| Dimensions (mm) | | | Abutment dimensions (mm) | | | | | Factors | | | | Weight | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $d_3$ | $B_1$ | $B_2$ | $d_a$ max | $d_b$ min | $D_a$ max | $B_a$ min | $r_a$ max | e | $Y_1$ Fa/fr ≤ e | $Y_2$ Fa/fr > e | $Y_0$ | Bearing kg | Sleeve kg |
| 32 | 24 | 7 | 27 | 23 | 42.0 | 5 | 1.0 | 0.28 | 2.2 | 3.5 | 2.3 | 0.12 | 0.041 |
| 32 | 28 | 7 | 27 | 23 | 42.0 | 5 | 1.0 | 0.44 | 1.5 | 2.2 | 1.5 | 0.14 | 0.045 |
| 32 | 28 | 7 | 30 | 23 | 45.5 | 8 | 1.0 | 0.29 | 2.2 | 3.3 | 2.3 | 0.16 | 0.045 |
| 32 | 31 | 7 | 28 | 24 | 45.5 | 5 | 1.0 | 0.51 | 1.2 | 1.9 | 1.3 | 0.21 | 0.049 |
| 38 | 26 | 8 | 32 | 28 | 47.0 | 5 | 1.0 | 0.27 | 2.4 | 3.7 | 2.5 | 0.14 | 0.070 |
| 38 | 29 | 8 | 32 | 28 | 47.0 | 5 | 1.0 | 0.35 | 1.8 | 2.8 | 1.9 | 0.16 | 0.075 |
| 38 | 29 | 8 | 35 | 28 | 55.5 | 6 | 1.0 | 0.28 | 2.3 | 3.5 | 2.4 | 0.26 | 0.075 |
| 38 | 35 | 8 | 34 | 30 | 55.5 | 5 | 1.0 | 0.48 | 1.3 | 2.0 | 1.4 | 0.34 | 0.087 |
| 45 | 27 | 8 | 38 | 33 | 57.0 | 5 | 1.0 | 0.25 | 2.5 | 3.9 | 2.7 | 0.22 | 0.100 |
| 45 | 31 | 8 | 39 | 33 | 57.0 | 5 | 1.0 | 0.30 | 2.1 | 3.3 | 2.2 | 0.24 | 0.110 |
| 45 | 31 | 8 | 42 | 33 | 65.5 | 6 | 1.0 | 0.26 | 2.4 | 3.7 | 2.5 | 0.38 | 0.110 |
| 45 | 38 | 8 | 40 | 35 | 65.5 | 5 | 1.0 | 0.45 | 1.4 | 2.2 | 1.5 | 0.49 | 0.130 |
| 52 | 29 | 9 | 45 | 38 | 65.5 | 5 | 1.0 | 0.22 | 2.8 | 4.3 | 2.9 | 0.32 | 0.130 |
| 52 | 35 | 9 | 44 | 39 | 65.5 | 5 | 1.0 | 0.30 | 2.1 | 3.3 | 2.2 | 0.40 | 0.140 |
| 52 | 35 | 9 | 49 | 39 | 72.0 | 7 | 1.5 | 0.26 | 2.5 | 3.8 | 2.6 | 0.50 | 0.140 |
| 52 | 43 | 9 | 45 | 40 | 72.0 | 5 | 1.5 | 0.47 | 1.4 | 2.1 | 1.4 | 0.66 | 0.170 |
| 58 | 31 | 10 | 52 | 43 | 73.5 | 6 | 1.0 | 0.22 | 2.9 | 4.5 | 3.0 | 0.41 | 0.170 |
| 58 | 36 | 10 | 50 | 44 | 73.5 | 6 | 1.0 | 0.26 | 2.4 | 3.8 | 2.5 | 0.49 | 0.190 |
| 58 | 36 | 10 | 55 | 44 | 82.0 | 6 | 1.5 | 0.25 | 2.5 | 3.9 | 2.6 | 0.70 | 0.190 |
| 58 | 46 | 10 | 51 | 45 | 82.0 | 6 | 1.5 | 0.43 | 1.5 | 2.3 | 1.5 | 0.90 | 0.220 |
| 65 | 33 | 11 | 57 | 48 | 78.5 | 6 | 1.0 | 0.21 | 3.0 | 4.7 | 3.2 | 0.46 | 0.230 |
| 65 | 39 | 11 | 56 | 50 | 78.5 | 8 | 1.0 | 0.26 | 2.4 | 3.8 | 2.5 | 0.53 | 0.250 |
| 65 | 39 | 11 | 61 | 50 | 92.0 | 6 | 1.5 | 0.25 | 2.5 | 3.9 | 2.6 | 0.94 | 0.250 |
| 65 | 50 | 11 | 57 | 50 | 92.0 | 6 | 1.5 | 0.43 | 1.5 | 2.3 | 1.6 | 1.20 | 0.280 |
| 70 | 35 | 12 | 62 | 53 | 83.5 | 6 | 1.0 | 0.20 | 3.2 | 4.9 | 3.3 | 0.52 | 0.270 |
| 70 | 42 | 12 | 61 | 55 | 83.5 | 10 | 1.0 | 0.24 | 2.6 | 4.1 | 2.7 | 0.58 | 0.300 |
| 70 | 42 | 12 | 68 | 55 | 101.0 | 6 | 2.0 | 0.24 | 2.6 | 4.0 | 2.7 | 1.20 | 0.300 |
| 70 | 55 | 12 | 63 | 56 | 101.0 | 6 | 2.0 | 0.43 | 1.5 | 2.3 | 1.5 | 1.60 | 0.360 |
| 75 | 37 | 12 | 69 | 60 | 92.0 | 7 | 1.5 | 0.19 | 3.3 | 5.1 | 3.5 | 0.69 | 0.310 |
| 75 | 45 | 12 | 68 | 60 | 92.0 | 11 | 1.5 | 0.22 | 2.9 | 4.5 | 2.1 | 0.79 | 0.390 |
| 75 | 45 | 12 | 74 | 60 | 111.0 | 7 | 2.0 | 0.24 | 2.7 | 4.1 | 2.8 | 1.55 | 0.390 |
| 75 | 59 | 12 | 69 | 61 | 111.0 | 7 | 2.0 | 0.42 | 1.5 | 2.3 | 1.6 | 2.05 | 0.420 |
| 80 | 38 | 13 | 75 | 64 | 102.0 | 7 | 1.5 | 0.18 | 3.5 | 5.4 | 3.6 | 0.90 | 0.350 |
| 80 | 47 | 13 | 73 | 65 | 102.0 | 9 | 1.5 | 0.23 | 2.7 | 4.2 | 2.8 | 1.10 | 0.390 |
| 80 | 47 | 13 | 83 | 65 | 119.0 | 7 | 2.0 | 0.23 | 2.8 | 4.3 | 2.9 | 1.95 | 0.390 |
| 80 | 62 | 13 | 74 | 66 | 119.0 | 7 | 2.0 | 0.40 | 1.6 | 2.4 | 1.7 | 2.60 | 0.490 |
| 85 | 40 | 14 | 83 | 70 | 112.0 | 7 | 1.5 | 0.18 | 3.6 | 5.5 | 3.7 | 1.15 | 0.400 |
| 85 | 50 | 14 | 79 | 70 | 112.0 | 9 | 1.5 | 0.23 | 2.8 | 4.3 | 2.9 | 1.45 | 0.460 |
| 85 | 50 | 14 | 89 | 70 | 129.0 | 7 | 2.0 | 0.23 | 2.8 | 4.3 | 2.9 | 2.45 | 0.460 |
| 85 | 65 | 14 | 82 | 72 | 129.0 | 7 | 2.0 | 0.39 | 1.6 | 2.5 | 1.7 | 3.25 | 0.550 |
| 98 | 43 | 15 | 92 | 80 | 122.0 | 7 | 1.5 | 0.17 | 3.6 | 5.6 | 3.8 | 1.35 | 0.710 |
| 98 | 55 | 15 | 90 | 80 | 122.0 | 13 | 1.5 | 0.25 | 2.5 | 3.9 | 2.6 | 1.60 | 0.830 |
| 98 | 55 | 15 | 100 | 80 | 149.0 | 7 | 2.0 | 0.22 | 2.8 | 4.4 | 3.0 | 3.55 | 0.830 |
| 98 | 73 | 15 | 94 | 82 | 149.0 | 7 | 2.0 | 0.38 | 1.6 | 2.6 | 1.7 | 5.15 | 1.050 |

## Sealed on both sides | Bore 12–65 mm

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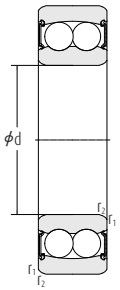
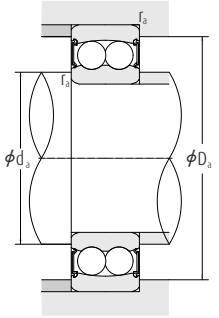


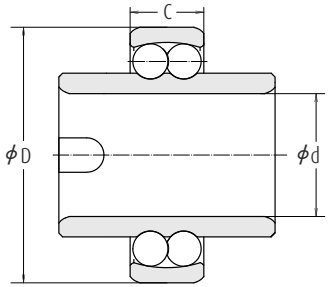

2RS

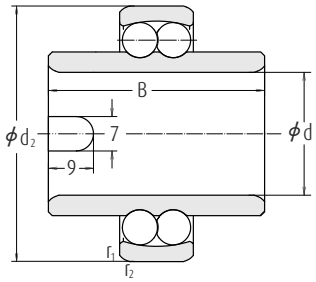
| Dimensions | | | | Load ratings | | Speed limits Grease | Abbreviation | |
|---|---|---|---|---|---|---|---|---|
| d | D | B | $r_{1,2}$ min | dyn. C | stat. $C_0$ | | Cylindrical bore | Tapered bore |
| | mm | | | kN | | $min^{-1}$ | | |
| **12** | 32 | 14 | 0.6 | 5.60 | 1.27 | 16 000 | 2201-2RSTNG | – |
| **15** | 35 | 14 | 0.6 | 7.50 | 1.76 | 15 000 | 2202-2RSTNG | – |
| | 42 | 17 | 1.0 | 9.50 | 2.28 | 15 000 | 2302-2RSTN | – |
| **17** | 40 | 16 | 0.6 | 8.00 | 2.04 | 14 000 | 2203-2RSTNG | – |
| | 47 | 19 | 1.0 | 12.50 | 3.20 | 11 000 | 2303-2RSTN | – |
| **20** | 47 | 18 | 1.0 | 10.00 | 2.65 | 11 000 | 2204-2RSTNG | 2204K2RSTNG |
| | 52 | 21 | 1.1 | 12.50 | 3.35 | 10 000 | 2304-2RSTNG | 2304K2RSTNG |
| **25** | 52 | 18 | 1.0 | 12.20 | 3.35 | 9 500 | 2205-2RSTNG | 2205K2RSTNG |
| | 62 | 24 | 1.1 | 18.00 | 5.00 | 8 000 | 2305-2RSTNG | 2305K2RSTNG |
| **30** | 62 | 20 | 1.0 | 15.60 | 4.65 | 8 000 | 2206-2RSTNG | 2206K2RSTNG |
| | 72 | 27 | 1.1 | 21.20 | 6.30 | 6 700 | 2306-2RSTNG | 2306K2RSTNG |
| **35** | 72 | 23 | 1.1 | 16.00 | 5.20 | 7 000 | 2207-2RSTNG | 2207K2RSTNG |
| | 80 | 31 | 1.5 | 25.00 | 8.00 | 6 000 | 2307-2RSTNG | 2307K2RSTNG |
| **40** | 80 | 23 | 1.1 | 19.30 | 6.55 | 6 300 | 2208-2RSTNG | 2208K2RSTNG |
| | 90 | 33 | 1.5 | 29.00 | 9.65 | 5 300 | 2308-2RSTNG | 2308K2RSTNG |
| **45** | 85 | 23 | 1.1 | 22.00 | 7.35 | 5 600 | 2209-2RSTNG | 2209K2RSTNG |
| | 100 | 36 | 1.5 | 38.00 | 12.90 | 4 800 | 2309-2RSTNG | 2309K2RSTNG |
| **50** | 90 | 23 | 1.1 | 22.80 | 8.15 | 5 300 | 2210-2RSTNG | 2210K2RSTNG |
| | 100 | 40 | 2.0 | 41.50 | 14.30 | 4 300 | 2310-2RSTNG | 2310K2RSTNG |
| **55** | 100 | 25 | 1.5 | 27.00 | 10.00 | 4 800 | 2211-2RSTNG | 2211K2RSTNG |
| | 120 | 43 | 2.0 | 51.00 | 18.00 | 3 800 | 2311-2RSTNG | 2311K2RSTNG |
| **60** | 110 | 28 | 1.5 | 30.00 | 11.60 | 4 300 | 2212-2RSTNG | 2212K2RSTNG |
| **65** | 120 | 31 | 1.5 | 31.00 | 12.40 | 4 000 | 2213-2RSTNG | 2213K2RSTNG |




| Abutment dimensions (mm) | | | Factors | | | | Weight |
|---|---|---|---|---|---|---|---|
| $d_a$ min | $D_a$ max | $r_a$ max | e | $Y_1$ Fa/fr ≤ e | $Y_2$ Fa/fr > e | $Y_0$ | |
| | mm | | | | | | kg |
| 16.0 | 28.0 | 0.6 | 0.37 | 1.7 | 2.6 | 1.8 | 0.06 |
| 19.0 | 31.0 | 0.6 | 0.34 | 1.9 | 2.9 | 2.0 | 0.06 |
| 20.0 | 37.0 | 1.0 | 0.35 | 1.8 | 2.8 | 1.9 | 0.13 |
| 21.0 | 36.0 | 0.6 | 0.33 | 1.9 | 3.0 | 2.0 | 0.10 |
| 22.0 | 42.0 | 1.0 | 0.32 | 1.9 | 3.0 | 2.0 | 0.18 |
| 25.0 | 42.0 | 1.0 | 0.28 | 2.2 | 3.5 | 2.3 | 0.16 |
| 26.5 | 45.5 | 1.0 | 0.29 | 2.2 | 3.3 | 2.3 | 0.24 |
| 30.0 | 47.0 | 1.0 | 0.27 | 2.4 | 3.7 | 2.5 | 0.17 |
| 31.5 | 55.5 | 1.0 | 0.28 | 2.3 | 3.5 | 2.4 | 0.38 |
| 35.0 | 57.0 | 1.0 | 0.25 | 2.5 | 3.9 | 2.7 | 0.28 |
| 36.5 | 65.5 | 1.0 | 0.26 | 2.4 | 3.7 | 2.5 | 0.57 |
| 41.4 | 65.5 | 1.0 | 0.22 | 2.8 | 4.3 | 2.9 | 0.45 |
| 43.0 | 72.0 | 1.5 | 0.26 | 2.5 | 3.8 | 2.6 | 0.79 |
| 46.5 | 73.5 | 1.0 | 0.22 | 2.9 | 4.5 | 3.0 | 0.55 |
| 48.0 | 82.0 | 1.5 | 0.25 | 2.5 | 3.9 | 2.6 | 0.05 |
| 51.5 | 78.5 | 1.0 | 0.21 | 3.0 | 4.7 | 3.2 | 0.58 |
| 53.0 | 92.0 | 1.5 | 0.25 | 2.5 | 3.9 | 2.6 | 0.40 |
| 56.5 | 83.5 | 1.0 | 0.20 | 3.2 | 4.9 | 3.3 | 0.63 |
| 59.0 | 101.0 | 2.0 | 0.24 | 2.6 | 4.0 | 2.7 | 1.89 |
| 63.0 | 92.0 | 1.5 | 0.19 | 3.3 | 5.1 | 3.5 | 0.76 |
| 66.0 | 109.0 | 2.0 | 0.24 | 2.7 | 4.1 | 2.8 | 2.37 |
| 68.5 | 101.5 | 1.5 | 0.18 | 3.5 | 5.4 | 3.6 | 1.11 |
| 74.0 | 111.0 | 1.5 | 0.18 | 3.6 | 5.5 | 3.7 | 1.53 |

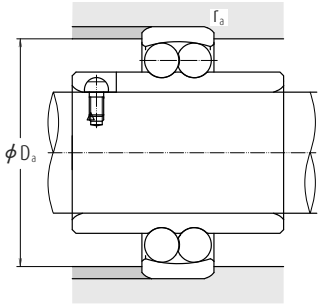
## With extended inner ring | Bore 20–60 mm



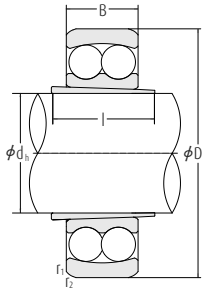

| Dimensions | | | | Load ratings | | Speed limits Grease | Abbreviation |
|---|---|---|---|---|---|---|---|
| d | D | B | $r_{1,2}$ min | dyn. C | stat. $C_0$ | | |
| | mm | | | kN | | $min^{-1}$ | |
| **20** | 47 | 14 | 1.0 | 10.0 | 2.65 | 9 000 | 11204TNG |
| | 52 | 15 | 1.0 | 12.5 | 3.20 | 8 500 | 11304TNG |
| **25** | 52 | 15 | 1.0 | 12.2 | 3.35 | 8 000 | 11205TNG |
| | 62 | 17 | 1.0 | 18.0 | 5.00 | 6 700 | 11305TNG |
| **30** | 62 | 16 | 1.0 | 15.6 | 4.65 | 6 700 | 11206TNG |
| | 72 | 19 | 1.0 | 21.2 | 6.30 | 5 600 | 11306TNG |
| **35** | 72 | 17 | 1.1 | 16.0 | 5.20 | 5 600 | 11207TNG |
| | 80 | 21 | 1.1 | 25.0 | 8.00 | 5 000 | 11307TNG |
| **40** | 80 | 18 | 1.1 | 19.3 | 6.55 | 5 000 | 11208TNG |
| | 90 | 23 | 1.1 | 29.0 | 9.65 | 4 500 | 11308TNG |
| **45** | 85 | 19 | 1.1 | 22.0 | 7.35 | 4 500 | 11209TNG |
| | 100 | 25 | 1.1 | 38.0 | 12.90 | 3 800 | 11309TNG |
| **50** | 90 | 20 | 1.1 | 22.8 | 8.15 | 4 300 | 11210TNG |
| | 110 | 27 | 1.1 | 41.5 | 14.30 | 3 600 | 11310TNG |
| **55** | 100 | 21 | 1.5 | 27.0 | 10.00 | 4 000 | 11211TNG |
| **60** | 110 | 22 | 1.5 | 30.0 | 11.60 | 3 600 | 11212TNG |

**Note** The bore tolerances do not comply with DIN 620. The bore tolerance corresponds to the tolerance zone J7.



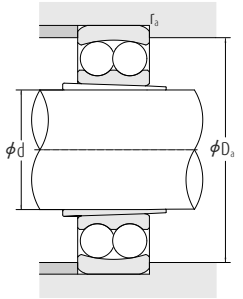

| Dimensions | | Abutment dimensions | | Factors | | | | Weight |
|---|---|---|---|---|---|---|---|---|
| $d_2$ | B | $D_a$ max | $r_a$ max | e | $Y_1$ Fa/Fr ≤ e | $Y_2$ Fa/fr > e | $Y_0$ | |
| mm | | | | | | | | kg |
| 29.2 | 40 | 42.0 | 1.0 | 0.28 | 2.2 | 3.5 | 2.3 | 0.18 |
| 31.5 | 44 | 45.5 | 1.0 | 0.29 | 2.2 | 3.3 | 2.3 | 0.28 |
| 33.3 | 44 | 47.0 | 1.0 | 0.27 | 2.4 | 3.7 | 2.5 | 0.22 |
| 38.0 | 48 | 55.5 | 1.0 | 0.28 | 2.3 | 3.5 | 2.4 | 0.43 |
| 40.1 | 48 | 57.0 | 1.0 | 0.25 | 2.5 | 3.9 | 2.7 | 0.35 |
| 45.0 | 52 | 65.5 | 1.0 | 0.26 | 2.4 | 3.7 | 2.5 | 0.64 |
| 47.7 | 52 | 65.5 | 1.0 | 0.22 | 2.8 | 4.3 | 2.9 | 0.54 |
| 51.7 | 56 | 72.0 | 1.0 | 0.26 | 2.5 | 3.8 | 2.6 | 0.85 |
| 54.0 | 56 | 73.5 | 1.0 | 0.22 | 2.9 | 4.5 | 3.0 | 0.72 |
| 57.7 | 58 | 82.0 | 1.0 | 0.25 | 2.5 | 3.9 | 2.6 | 1.12 |
| 57.7 | 58 | 78.5 | 1.0 | 0.21 | 3.0 | 4.7 | 3.2 | 0.77 |
| 63.9 | 60 | 92.0 | 1.0 | 0.25 | 2.5 | 3.9 | 2.6 | 1.43 |
| 62.7 | 58 | 83.5 | 1.0 | 0.20 | 3.2 | 4.9 | 3.3 | 0.85 |
| 70.3 | 62 | 83.5 | 1.0 | 0.24 | 2.6 | 4.0 | 2.7 | 1.82 |
| 70.3 | 60 | 92.0 | 1.5 | 0.19 | 3.3 | 5.1 | 3.5 | 1.17 |
| 78.0 | 62 | 102.0 | 1.5 | 0.18 | 3.5 | 5.4 | 3.6 | 1.50 |

## Sleeve | Shaft 20–50 mm




| Dimensions | | | | | | Load ratings | | Abbreviation |
|---|---|---|---|---|---|---|---|---|
| d Shaft | $d_h$ | D | B | l | $r_{1,2}$ min | dyn. C | stat. $C_0$ | |
| | | mm | | | | kN | | |
| **20** | 20 | 47 | 14 | 23 | 1.0 | 10.0 | 2.65 | 11504TNG |
| **25** | 25 | 52 | 15 | 25 | 1.0 | 12.2 | 3.35 | 11505TNG |
| **30** | 30 | 62 | 16 | 25 | 1.0 | 15.6 | 4.65 | 11506TNG |
| **35** | 35 | 72 | 17 | 26 | 1.1 | 16.0 | 5.20 | 11507TNG |
| **40** | 40 | 80 | 18 | 27 | 1.1 | 19.3 | 6.55 | 11508TNG |
| **45** | 45 | 85 | 19 | 28 | 1.1 | 22.0 | 7.35 | 11509TNG |
| **50** | 50 | 90 | 20 | 30 | 1.1 | 22.8 | 8.15 | 11510TNG |

**Note** The bore of the inner ring and its 1:15 taper do not comply with DIN 616.




| Speed limits | | Abutment dimensions | | Factors | | | | Weight |
|---|---|---|---|---|---|---|---|---|
| Grease | Oil | $D_a$ max | $r_a$ max | e | $Y_1$ | $Y_2$ | $Y_0$ | |
| $min^{-1}$ | | mm | | | Fa/Fr ≤ e | Fa/fr > e | | kg |
| 15 000 | 18 000 | 41.0 | 1.0 | 0.28 | 2.2 | 3.5 | 2.3 | 0.120 |
| 13 000 | 16 000 | 46.5 | 1.0 | 0.27 | 2.4 | 3.7 | 2.5 | 0.144 |
| 11 000 | 14 000 | 56.5 | 1.0 | 0.25 | 2.5 | 3.9 | 2.7 | 0.227 |
| 9 500 | 12 000 | 65.0 | 1.0 | 0.22 | 2.8 | 4.3 | 2.9 | 0.335 |
| 8 500 | 10 000 | 73.0 | 1.0 | 0.22 | 2.9 | 4.5 | 3.0 | 0.435 |
| 7 500 | 9 000 | 78.0 | 1.0 | 0.21 | 3.0 | 4.7 | 3.2 | 0.480 |
| 7 000 | 8 500 | 83.0 | 1.0 | 0.20 | 3.2 | 4.9 | 3.3 | 0.540 |



## 5. CYLINDRICAL ROLLER BEARINGS

### SINGLE-ROW AND DOUBLE-ROW CYLINDRICAL ROLLER BEARINGS

Introduction ..... B 142

### TECHNICAL DATA

Free Space of Cylindrical Roller Bearings ..... B 148

### BEARINGS TABLE

#### SINGLE-ROW CYLINDRICAL ROLLER BEARINGS

Bore Dia. — Page
20 – 500 mm ..... B 150

#### L-SHAPED THRUST COLLARS FOR CYLINDRICAL ROLLER BEARINGS

Bore Dia. — Page
20 – 320 mm ..... B 174

#### DOUBLE-ROW CYLINDRICAL ROLLER BEARINGS

Bore Dia. — Page
25 – 360 mm ..... B 176

### FULL COMPLEMENT CYLINDRICAL ROLLER BEARINGS SINGLE-ROW(NCF), DOUBLE-ROW(NNCF) AND FOR SHEAVES

Introduction ..... B 180

### BEARINGS TABLE

#### SINGLE-ROW(NCF)

Bore Dia. — Page
100 – 800 mm ..... B 184

#### DOUBLE-ROW(NNCF)

Bore Dia. — Page
100 – 500 mm ..... B 188

#### FOR SHEAVES OPEN TYPE FIXED-END BEARING RS-48E4, RS-49E4 FREE-END BEARING RSF-48E4, RSF-49E4

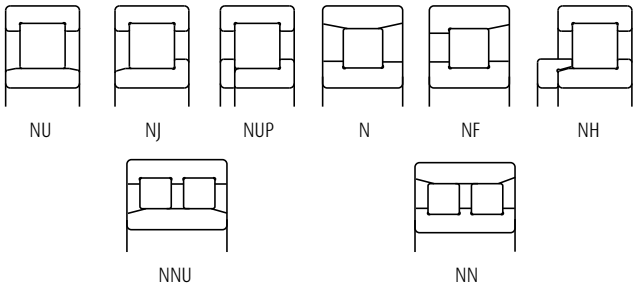
Bore Dia. — Page
50 – 560 mm ..... B 192

#### FOR SHEAVES PRELUBRICATED TYPE RS-50, RS-50NR

Bore Dia. — Page
40 – 400 mm ..... B 196

## DESIGN, TYPES, AND FEATURES

Depending on the existence of ribs on their rings, Cylindrical Roller Bearings are classified into the following types.




Types NU, N, NNU, and NN are suitable as free-end bearings. Types NJ and NF can sustain limited axial loads in one direction. Types NH and NUP can be used as fixed-end bearings.

NH-type cylindrical roller bearings consist of the NJ-type cylindrical roller bearings and HJ-type L-shaped thrust collars (See Pages B156 to B157).

The inner ring loose rib of a NUP-type cylindrical roller bearing should be mounted so that the marked side is on the outside.

### Features of Single-Row Cylindrical Roller Bearings

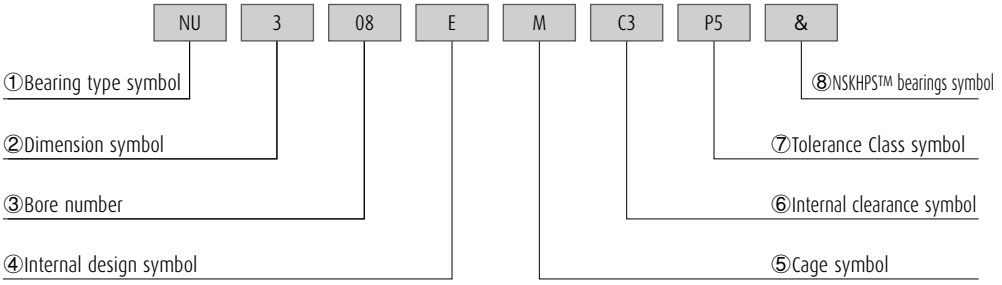
| Cage Specification | Material | Steel | Steel | Polyamide 66 resin | L-PPS resin | Brass | |
|---|---|---|---|---|---|---|---|
| | Method | pressed | | Molded | | machined | |
| | Symbols | W | EW | ET | ET7 | M | EM |
| Features | High Load Capacity | ○ | ◎ | ◎ | ◎ | △ | ◎ |
| | High-Speed | △ | ○ | ○ | ○ | ○ | ◎ |
| | High-Temperature | ○ | ○ | △ | ○ | ○ | ○ |
| | Vibration | × | × | × | × | △ | ○ |

For a given bearing number, if the type of cage is not the standard one, the number of rollers may vary; in such a case, the load rating will differ from the one listed in the bearing tables.

Among the NN Type of double-row bearings, there are many of high precision that have tapered bores, and they are primarily used in the main spindles of machine tools. Their cages are either molded polyphenylenesulfide (PPS) or machined brass.

## ☐ Formulation of Bearing Numbers

Single-Row Cylindrical Rollers
Bearing number example:




| | |
|---|---|
| ①Bearing type symbol | NU : Single-Row Cylindrical Roller Bearings<br>(Outer ring with both ribs + Inner ring without ribs<br>Please refer to page B124 for detailed information. |
| ②Dimension symbol | 10 : 10 Series, 2: 02 Series, 22 : 22 Series, 3 : 03 Series, 23 : 23 Series, 4 : 04 Series, |
| ③Bore number | Less than 04, Bearing bore 01 : 12mm, 02 : 15mm, 03 : 17mm<br>Over 03, Bearing bore Bore number × 5 (mm) |
| ④Internal design symbol | E : High Load Capacity |
| ⑤Cage symbol | W : Pressed Steel Cage, M : Machined Brass Cage, No symbol : Machined Brass Cage<br>(In case of 10 Series) T : Polyamide 66 Resin Cage, T7 : L-PPS Resin Cage |
| ⑥Radial Internal clearance symbol | For All Radial Brgs.<br>Omitted : CN clearance, C3 : Clearance greater than CN, C4 : Clearance greater than C3, CT : Clearance for Electric Motors (for interchangable bearings), CG : Special Clearance<br>For Non-Interchangeable Cylindrical Roller Bearings<br>CC : Normal Clearance, CC3 : Clearance greater than CC, CC4 : Clearance greater than CC3, CM : Clearance for Electric Motors (for non-interchangable bearings), CCG : Special Clearance |
| ⑦Tolerance Class symbol | Omitted : ISO Normal, P6 : ISO Class 6, P5 : ISO Class 5, P4 : ISO Class 4 |
| ⑧NSKHPS™ symbol | &: NSKHPS™ bearings symbol |

### PRECAUTIONS FOR USE OF CYLINDRICAL ROLLER BEARINGS

If the load on cylindrical roller bearings becomes too small during operation, slippage between the rollers and raceways occurs, which may result in smearing. Especially with large bearings since the weight of the roller and cage is high.

In case of strong shock loads or vibration, pressed-steel cages are sometimes inadequate.

If very small bearing load or strong shock loads or vibration are expected, please consult with NSK for selection of the bearings.

Bearings with molded polyamide cages (ET type) can be used continuously at temperatures between -40 and 120°C.
If the bearings are used in gear oil, nonflammable hydraulic oil, or ester oil at a high temperature over 100°C, please contact NSK beforehand.

## TOLERANCES AND RUNNING ACCURACY


| | Table | Pages |
|---|---|---|
| Cylindrical Roller Bearings | 7.2 | A128 to A131 |
| Double-Row Cylindrical Roller Bearings | 7.2 | A128 to A131 |


### Table 2 Tolerances for Roller Inscribed Circle Diameter $F_w$ and Roller Circumscribed Circle Diameter $E_w$ of Cylindrical Roller Bearings Having Interchangeable Rings

Units : µm

| Nominal Bore Diameter d (mm) | | Tolerances for $F_w$ of types NU, NJ, NUP, NH, and NNU $\Delta_{F_w}$ | | Tolerances for $E_w$ of types N, NF, and NN $\Delta_{E_w}$ | |
|---|---|---|---|---|---|
| over | incl. | high | low | high | low |
| — | 20 | +10 | 0 | 0 | −10 |
| 20 | 50 | +15 | 0 | 0 | −15 |
| 50 | 120 | +20 | 0 | 0 | −20 |
| 120 | 200 | +25 | 0 | 0 | −25 |
| 200 | 250 | +30 | 0 | 0 | −30 |
| 250 | 315 | +35 | 0 | 0 | −35 |
| 315 | 400 | +40 | 0 | 0 | −40 |
| 400 | 500 | +45 | 0 | – | – |

## RECOMMENDED FITS


| | Table | Page |
|---|---|---|
| Cylindrical Roller Bearings | 8.3 | A164 |
| | 8.5 | A165 |
| Double-Row Cylindrical Roller Bearings | 8.3 | A164 |
| | 8.5 | A165 |


## INTERNAL CLEARANCES


| | Table | Page |
|---|---|---|
| CT and CM clearance fo Electric Motors | 8.14.2 | A170 |
| Double-Row Cylindrical Roller Bearings | 8.15 | A171 |


## PERMISSIBLE MISALIGNMENT

The permissible misalignment of cylindrical roller bearings varies depending on the type and internal specifications, but under normal loads, the angles are approximately as follows:

Cylindrical Roller Bearings of width series 0 or 1 ..... 0.0012 radian (4′)

Cylindrical Roller Bearings of width series 2 ..... 0.0006 radian (2′)

For double-row cylindrical roller bearings, nearly no misalignment is allowed.

### LIMITING SPEEDS (Mechanical)

In some single row cylindrical roller bearings, optional cage types are available for special purposes or customer requests. Please consult with NSK about the limiting speeds (mechanical) in the bearing tables are the values for the standard cage type. Refer to point 5.3 on page A099 for detailed information. The limiting speeds (mechanical) in the bearing tab the limiting speeds (mechanical) of optional cage.

### LIMITING SPEEDS (Grease/Oil)

The limiting speeds (grease) and limiting speeds (oil) listed in the bearing tables should be adjusted depending on the bearing load condition. Also, higher speeds are attainable by making changes in the lubrication method, cage design, etc. Refer to page A098 for detailed information.

## TECHNICAL DATA

### Free Space of Cylindrical Roller Bearings

Cylindrical roller bearings employ grease lubrication in many cases because it makes maintenance easier and simplifies the peripheral construction of the housing. It is essential to select a grease brand appropriate for the operating conditions while paying due attention to the filling amount and position of the bearing as well as its housing.

The cylindrical roller bearings can be divided into NU, NJ, N, NF, NH, and NUP types of construction according to the collar, collar ring, and position of the inner or outer ring ribs. Even if bearings belong to the same dimension series, they may have different amounts of free space. The free space also differs depending on whether the cage provided is made from pressed steel or from machined high-tension brass. When determining the grease filling amount, please refer to Tables 1 and 2 which show the free space of NU type bearings. (By the way, the cylindrical roller bearing type is used most frequently).

For types other than the NU type, the free space can be determined from the free space ratio with the NU type. Table 3 shows the approximate free space ratio for each type of cylindrical roller bearing. For example, the free space of NJ310 with a pressed steel cage may be calculated approximately at 47 $cm^3$. This result was calculated by multiplying the free space 52 $cm^3$ of NU310 in Table 1 by the space ratio 0.90 for the NJ type (Table 3).

**Table 1 Free Space of Cylindrical Roller Bearing (NU Type) (1) (with Pressed Cage)**

Units: $cm^3$

| Bearing bore No. | Bearing free space | | | |
|---|---|---|---|---|
| | Bearing series | | | |
| | NU2 | NU3 | NU22 | NU23 |
| 05 | 6.6 | 11 | 7.8 | 16 |
| 06 | 9.6 | 17 | 12 | 24 |
| 07 | 14 | 22 | 14 | 35 |
| 08 | 18 | 31 | 22 | 44 |
| 09 | 20 | 42 | 23 | 62 |
| 10 | 23 | 52 | 26 | 80 |
| 11 | 30 | 68 | 35 | 102 |
| 12 | 37 | 85 | 45 | 130 |
| 13 | 44 | 107 | 57 | 156 |
| 14 | 51 | 124 | 62 | 179 |
| 15 | 58 | 155 | 70 | 226 |
| 16 | 71 | 177 | 85 | 260 |
| 17 | 85 | 210 | 104 | 300 |
| 18 | 103 | 244 | 134 | 365 |
| 19 | 132 | 283 | 164 | 415 |
| 20 | 151 | 335 | 200 | 540 |

## Table 2 Free Space of Cylindrical Roller Bearing (NU Type) (2) (with High-Tension Brass Machined Cage)

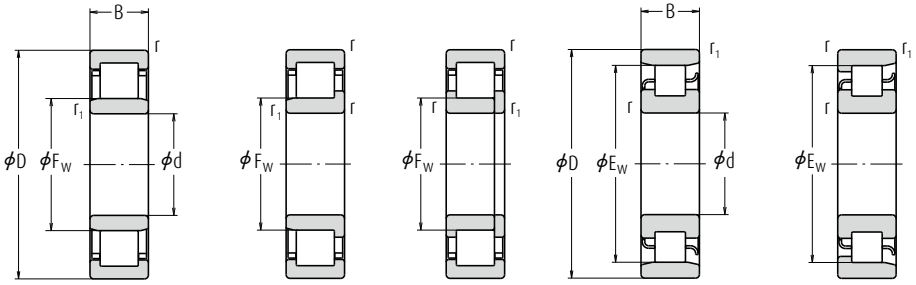
Units: $cm^3$

| Bearing bore No. | Bearing free space | | | |
|---|---|---|---|---|
| | Bearing series | | | |
| | NU2 | NU3 | NU22 | NU23 |
| 05 | 5.0 | 7.6 | 5.7 | 10 |
| 06 | 7.4 | 12 | 7.9 | 16 |
| 07 | 9.6 | 16 | 12 | 27 |
| | | | | |
| 08 | 12 | 21 | 15 | 32 |
| 09 | 15 | 29 | 16 | 45 |
| 10 | 18 | 38 | 17 | 58 |
| | | | | |
| 11 | 22 | 52 | 24 | 77 |
| 12 | 26 | 62 | 31 | 88 |
| 13 | 31 | 74 | 43 | 104 |
| | | | | |
| 14 | 37 | 92 | 44 | 129 |
| 15 | 42 | 102 | 50 | 149 |
| 16 | 51 | 122 | 60 | 181 |
| | | | | |
| 17 | 64 | 164 | 74 | 200 |
| 18 | 79 | 193 | 96 | 279 |
| 19 | 94 | 218 | 116 | 280 |
| 20 | 115 | 221 | 137 | 355 |

## Table 3 Free Space Ratio of Each Type of Cylindrical Roller Bearing

| NU Type | NJ Type | N Type | NF Type |
|---|---|---|---|
| 1 | 0.90 | 1.05 | 0.95 |

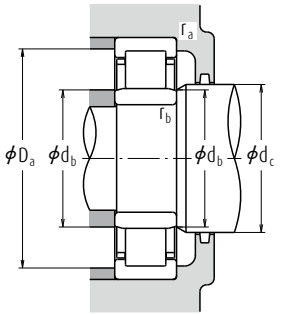
## Bore Diameter 20 – 30 mm

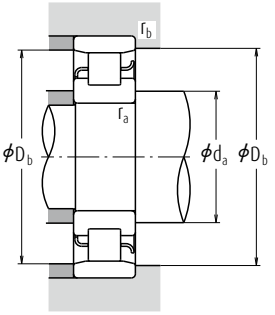


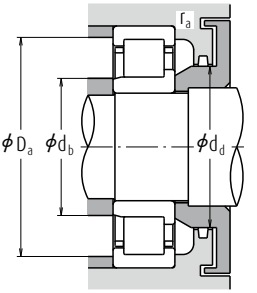

NU NJ NUP N NF

| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Speeds (min⁻¹) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Limiting Speeds | |
| d | D | B | r min. | r1 min. | $F_W$ | $E_W$ | $C_r$ | $C_{0r}$ | Thermal Reference Speed | Mechanical (5) | Grease |
| **20** | 47 | 14 | 1.0 | 0.6 | – | 40 | 15 400 | 12 700 | 15 400 | – | 12 000 |
| | 47 | 14 | 1.0 | 0.6 | 26.5 | – | 25 700 | 22 600 | 16 000 | – | 13 000 |
| | 47 | 18 | 1.0 | 0.6 | 27.0 | – | 20 700 | 18 400 | 19 000 | – | 11 000 |
| | 47 | 18 | 1.0 | 0.6 | 26.5 | – | 30 500 | 28 300 | 19 000 | – | 11 000 |
| | 52 | 15 | 1.1 | 0.6 | – | 44.5 | 21 400 | 17 300 | 14 000 | – | 10 000 |
| | 52 | 15 | 1.1 | 0.6 | 27.5 | – | 31 500 | 26 900 | 13 000 | – | 12 000 |
| | 52 | 21 | 1.1 | 0.6 | 28.5 | – | 30 500 | 27 200 | 14 000 | – | 11 000 |
| | 52 | 21 | 1.1 | 0.6 | 27.5 | – | 42 000 | 39 000 | 13 000 | – | 11 000 |
| **25** | 47 | 12 | 0.6 | 0.3 | 30.5 | – | 14 300 | 13 100 | 15 000 | – | 15 000 |
| | 52 | 15 | 1.0 | 0.6 | – | 45 | 17 700 | 15 700 | 17 700 | – | 10 000 |
| | 52 | 15 | 1.0 | 0.6 | 31.5 | – | 33 500 | 27 700 | 14 000 | 17 000 | 12 000 |
| | 52 | 15 | 1.0 | 0.6 | 31.5 | – | 29 300 | 27 700 | 14 000 | 17 000 | 12 000 |
| | 52 | 18 | 1.0 | 0.6 | 31.5 | – | 40 000 | 34 500 | 14 000 | 20 000 | 12 000 |
| | 52 | 18 | 1.0 | 0.6 | 31.5 | – | 35 000 | 34 500 | 14 000 | 20 000 | 12 000 |
| | 62 | 17 | 1.1 | 1.1 | – | 53 | 29 300 | 25 200 | 12 000 | – | 8 000 |
| | 62 | 17 | 1.1 | 1.1 | 34.0 | – | 48 000 | 37 500 | 11 000 | 15 000 | 10 000 |
| | 62 | 17 | 1.1 | 1.1 | 34.0 | – | 41 500 | 37 500 | 11 000 | 15 000 | 10 000 |
| | 62 | 24 | 1.1 | 1.1 | 34.0 | – | 65 500 | 56 000 | 11 000 | 18 000 | 9 000 |
| | 62 | 24 | 1.1 | 1.1 | 34.0 | – | 57 000 | 56 000 | 11 000 | 18 000 | 9 000 |
| | 80 | 21 | 1.5 | 1.5 | 38.8 | 62.8 | 46 500 | 40 000 | 9 500 | – | 7 100 |
| **30** | 55 | 13 | 1.0 | 0.6 | 36.5 | 48.5 | 19 700 | 19 600 | 13 000 | – | 12 000 |
| | 62 | 16 | 1.0 | 0.6 | – | 53.5 | 24 900 | 23 300 | 13 000 | – | 8 500 |
| | 62 | 16 | 1.0 | 0.6 | 37.5 | – | 45 000 | 37 500 | 12 000 | 14 000 | 9 500 |
| | 62 | 16 | 1.0 | 0.6 | 37.5 | – | 39 000 | 37 500 | 12 000 | 14 000 | 9 500 |
| | 62 | 20 | 1.0 | 0.6 | 37.5 | – | 56 500 | 50 000 | 12 000 | 17 000 | 9 500 |
| | 62 | 20 | 1.0 | 0.6 | 37.5 | – | 49 000 | 50 000 | 12 000 | 17 000 | 9 500 |
| | 72 | 19 | 1.1 | 1.1 | – | 62 | 38 500 | 35 000 | 10 000 | – | 7 100 |
| | 72 | 19 | 1.1 | 1.1 | 40.5 | – | 61 000 | 50 000 | 9 500 | 13 000 | 8 500 |
| | 72 | 19 | 1.1 | 1.1 | 40.5 | – | 53 000 | 50 000 | 9 500 | 13 000 | 8 500 |
| | 72 | 27 | 1.1 | 1.1 | 40.5 | – | 86 000 | 77 500 | 9 500 | 16 000 | 8 000 |
| | 72 | 27 | 1.1 | 1.1 | 40.5 | – | 74 500 | 77 500 | 9 500 | 16 000 | 8 000 |
| | 90 | 23 | 1.5 | 1.5 | 45.0 | 73 | 62 500 | 55 000 | 8 500 | – | 6 000 |

**Notes** (1) (M) in the column of cage symbols are usually omitted from the bearing number.
(2) When L-Shaped thrust collars (See section for L-Shaped Thrust Collars starting on page **B174**) are used, the bearings become the NH type.



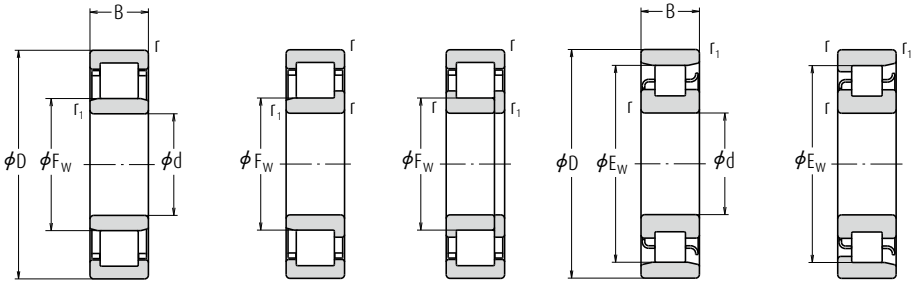




| Bearing Numbers | | | | | | | | Abutment and Fillet Dimensions (mm) | | | | | | | | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cage symbol (1) Standard option | | NU | (2) NJ | NUP | N | NF | $d_a$(3) min. | $d_b$ min. | $d_b$(4) max. | $d_c$ min. | $d_d$ min. | $D_a$(3) max. | $D_b$ max. | $D_b$ min. | $r_a$ max. | $r_b$ max. | approx. |
| **N 204** | **W** | — | — | — | — | **N** | **NF** | 25 | — | — | — | — | — | 43 | 42 | 1 | 0.6 | 0.107 |
| **NU 204 E** | **T** | **T7** | **NU** | **NJ** | **NUP** | — | — | 25 | 24 | 25 | 29 | 32 | 42 | — | — | 1 | 0.6 | 0.107 |
| **NU 2204** | **W** | **M** | **NU** | **NJ** | — | — | — | 25 | 24 | 25 | 29 | 32 | 42 | — | — | 1 | 0.6 | 0.144 |
| **NU 2204 ET** | — | — | **NU** | **NJ** | **NUP** | — | — | 25 | 24 | 25 | 29 | 32 | 42 | — | — | 1 | 0.6 | 0.138 |
| **N 304** | **W** | — | — | — | — | **N** | **NF** | 26.5 | — | — | — | — | — | 48 | 46 | 1 | 0.6 | 0.148 |
| **NU 304 E** | **T** | **T7** | **NU** | **NJ** | **NUP** | — | — | 26.5 | 24 | 26 | 30 | 33 | 45.5 | — | — | 1 | 0.6 | 0.145 |
| **NU 2304** | **M** | — | **NU** | **NJ** | **NUP** | — | — | 26.5 | 24 | 27 | 30 | 33 | 45.5 | — | — | 1 | 0.6 | 0.217 |
| **NU 2304 E** | **T7** | — | **NU** | **NJ** | **NUP** | — | — | 26.5 | 24 | 26 | 30 | 33 | 45.5 | — | — | 1 | 0.6 | 0.209 |
| **NU 1005** | **(M)** | — | **NU** | — | — | — | — | — | 27 | 30 | 32 | — | 43 | — | — | 0.6 | 0.3 | 0.094 |
| **N 205** | **W** | **M** | — | — | — | **N** | **NF** | 30 | — | — | — | — | — | 48 | 46 | 1 | 0.6 | 0.135 |
| **NU 205 E*** | **W** | **M,T,T7** | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| **NU 205 E** | **W** | **M,T,T7** | **NU** | **NJ** | **NUP** | — | — | 30 | 29 | 30 | 34 | 37 | 47 | — | — | 1 | 0.6 | 0.136 |
| **NU 2205 E*** | **M** | **T,T7** | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| **NU 2205 E** | **M** | **T,T7** | **NU** | **NJ** | **NUP** | — | — | 30 | 29 | 30 | 34 | 37 | 47 | — | — | 1 | 0.6 | 0.16 |
| **N 305** | **W** | **M** | — | — | — | **N** | **NF** | 31.5 | — | — | — | — | — | 55.5 | 50 | 1 | 1 | 0.233 |
| **NU 305 E*** | **W** | **M,T,T7** | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| **NU 305 E** | **W** | **M,T,T7** | **NU** | **NJ** | **NUP** | — | — | 31.5 | 31.5 | 32 | 37 | 40 | 55.5 | — | — | 1 | 1 | 0.269 |
| **NU 2305 E*** | **M** | **T, T7** | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| **NU 2305 E** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | — | — | 31.5 | 31.5 | 32 | 37 | 40 | 55.5 | — | — | 1 | 1 | 0.338 |
| **NU 405** | **W** | — | **NU** | **NJ** | — | **N** | **NF** | 33 | 33 | 37 | 41 | 46 | 72 | 72 | 64 | 1.5 | 1.5 | 0.57 |
| **NU 1006** | **(M)** | — | **NU** | — | — | **N** | — | 35 | 34 | 36 | 38 | — | 50 | 51 | 49 | 1 | 0.5 | 0.136 |
| **N 206** | **W** | **M** | — | — | — | **N** | **NF** | 35 | — | — | — | — | — | 58 | 56 | 1 | 0.6 | 0.208 |
| **NU 206 E*** | **W** | **M,T,T7** | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| **NU 206 E** | **W** | **M,T,T7** | **NU** | **NJ** | **NUP** | — | — | 35 | 34 | 36 | 40 | 44 | 57 | — | — | 1 | 0.6 | 0.205 |
| **NU 2206 E*** | **M** | **T, T7** | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| **NU 2206 E** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | — | — | 35 | 34 | 36 | 40 | 44 | 57 | — | — | 1 | 0.6 | 0.255 |
| **N 306** | **W** | **M** | — | — | — | **N** | **NF** | 36.5 | — | — | — | — | — | 65.5 | 64 | 1 | 1 | 0.353 |
| **NU 306 E*** | **W** | **M,T,T7** | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| **NU 306 E** | **W** | **M,T,T7** | **NU** | **NJ** | **NUP** | — | — | 36.5 | 36.5 | 39 | 44 | 48 | 65.5 | — | — | 1 | 1 | 0.409 |
| **NU 2306 E*** | **M** | **T, T7** | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| **NU 2306 E** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | — | — | 36.5 | 36.5 | 39 | 44 | 48 | 65.5 | — | — | 1 | 1 | 0.518 |
| **NU 406** | **W** | **M** | **NU** | **NJ** | — | **N** | **NF** | 38 | 38 | 43 | 47 | 52 | 82 | 82 | 75 | 1.5 | 1.5 | 0.758 |

**Notes** (3) If axial loads are applied, increase $d_a$ and reduce $D_a$ from the values listed above.
(4) $d_b$ (max.) are values for adjusting rings for NU, NJ Types.
(5) The limiting speeds (mechanical) in the bearing tables are the value for the standard cage type.

**Remark** The bearings denoted by an asterisk (*) are NSKHPS Cylindrical roller bearings.

## Bore Diameter 35 – 40 mm



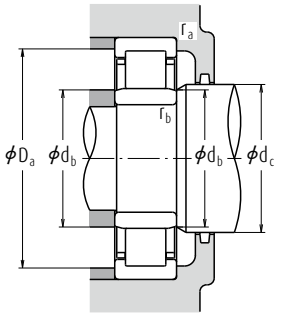

NU NJ NUP N NF

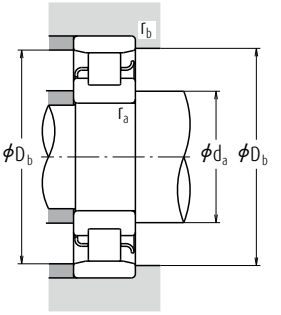
| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Speeds (min⁻¹) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Thermal Reference Speed | Limiting Speeds | |
| d | D | B | r min. | r1 min. | $F_W$ | $E_W$ | $C_r$ | $C_{0r}$ | | Mechanical (5) | Grease |
| **35** | 62 | 14 | 1.0 | 0.6 | 42.0 | 55 | 22 600 | 23 200 | 11 000 | – | 11 000 |
| | 72 | 17 | 1.1 | 0.6 | – | 61.8 | 35 500 | 34 000 | 11 000 | – | 7 500 |
| | 72 | 17 | 1.1 | 0.6 | 44.0 | – | 58 000 | 50 000 | 10 000 | 12 000 | 8 500 |
| | 72 | 17 | 1.1 | 0.6 | 44.0 | – | 50 500 | 50 000 | 10 000 | 12 000 | 8 500 |
| | 72 | 23 | 1.1 | 0.6 | 44.0 | – | 71 000 | 65 500 | 11 000 | 15 000 | 8 500 |
| | 72 | 23 | 1.1 | 0.6 | 44.0 | – | 61 500 | 65 500 | 11 000 | 15 000 | 8 500 |
| | 80 | 21 | 1.5 | 1.1 | – | 68.2 | 49 500 | 47 000 | 9 500 | – | 6 300 |
| | 80 | 21 | 1.5 | 1.1 | 46.2 | – | 76 500 | 65 500 | 8 500 | 11 000 | 7 500 |
| | 80 | 21 | 1.5 | 1.1 | 46.2 | – | 66 500 | 65 500 | 8 500 | 11 000 | 7 500 |
| | 80 | 31 | 1.5 | 1.1 | 46.2 | – | 107 000 | 101 000 | 9 000 | 14 000 | 6 700 |
| | 80 | 31 | 1.5 | 1.1 | 46.2 | – | 93 000 | 101 000 | 9 000 | 14 000 | 6 700 |
| | 100 | 25 | 1.5 | 1.5 | 53.0 | 83 | 75 500 | 69 000 | 7 500 | – | 5 300 |
| **40** | 68 | 15 | 1.0 | 0.6 | 47.0 | 61 | 27 300 | 29 000 | 10 000 | – | 10 000 |
| | 80 | 18 | 1.1 | 1.1 | – | 70 | 43 500 | 43 000 | 9 500 | – | 6 700 |
| | 80 | 18 | 1.1 | 1.1 | 49.5 | – | 64 000 | 55 500 | 9 000 | 11 000 | 7 500 |
| | 80 | 18 | 1.1 | 1.1 | 49.5 | – | 55 500 | 55 500 | 9 000 | 11 000 | 7 500 |
| | 80 | 23 | 1.1 | 1.1 | 49.5 | – | 83 000 | 77 500 | 9 000 | 13 000 | 7 500 |
| | 80 | 23 | 1.1 | 1.1 | 49.5 | – | 72 500 | 77 500 | 9 000 | 13 000 | 7 500 |
| | 90 | 23 | 1.5 | 1.5 | – | 77.5 | 58 500 | 57 000 | 8 500 | – | 5 600 |
| | 90 | 23 | 1.5 | 1.5 | 52.0 | – | 95 500 | 81 500 | 7 500 | 10 000 | 6 700 |
| | 90 | 23 | 1.5 | 1.5 | 52.0 | – | 83 000 | 81 500 | 7 500 | 10 000 | 6 700 |
| | 90 | 33 | 1.5 | 1.5 | 52.0 | – | 131 000 | 122 000 | 8 000 | 12 000 | 6 000 |
| | 90 | 33 | 1.5 | 1.5 | 52.0 | – | 114 000 | 122 000 | 8 000 | 12 000 | 6 000 |
| | 110 | 27 | 2.0 | 2.0 | 58.0 | 92 | 95 500 | 89 000 | 6 700 | – | 4 800 |

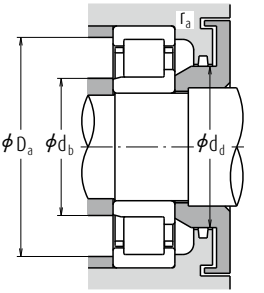
**Notes**

(1) (M) in the column of cage symbols are usually omitted from the bearing number.

(2) When L-Shaped thrust collars (See section for L-Shaped Thrust Collars starting on page **B174**) are used, the bearings become the NH type.



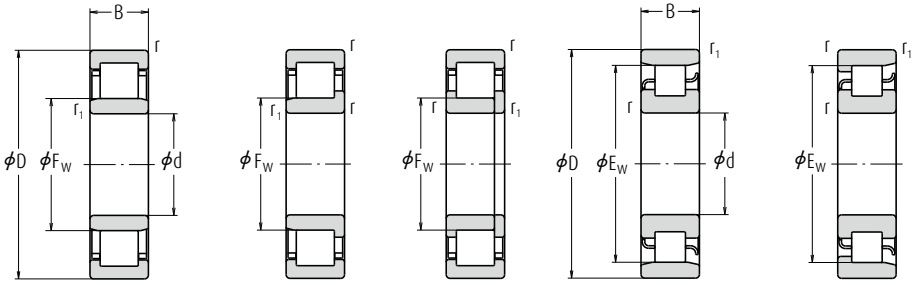




| Bearing Numbers | | | | | | | | Abutment and Fillet Dimensions (mm) | | | | | | | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cage symbol (1) Standard option | | NU | (2) NJ | NUP | N | NF | $d_a$(3) min. | $d_b$ min. | $d_b$(4) max. | $d_c$ min. | $d_d$ min. | $D_a$(3) max. | $D_b$ max. | $D_b$ min. | $r_a$ max. | $r_b$ max. | approx. |
| NU 1007 | (M) | — | NU | NJ | — | N | — | 40 | 39 | 41 | 44 | — | 57 | 58 | 56 | 1 | 0.5 | 0.18 |
| N 207 | W | M | — | — | — | N | NF | 41.5 | — | — | — | — | — | 68 | 64 | 1 | 0.6 | 0.301 |
| NU 207 E* | W | M,T,T7 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| NU 207 E | W | M,T,T7 | NU | NJ | NUP | — | — | 41.5 | 39 | 42 | 46 | 50 | 65.5 | — | — | 1 | 0.6 | 0.304 |
| NU 2207 E* | M | T, T7 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| NU 2207 E | M | T, T7 | NU | NJ | NUP | — | — | 41.5 | 39 | 42 | 46 | 50 | 65.5 | — | — | 1 | 0.6 | 0.40 |
| N 307 | W | M | — | — | — | N | NF | 43 | — | — | — | — | — | 73.5 | 70 | 1.5 | 1 | 0.476 |
| NU 307 E* | W | M,T,T7 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| NU 307 E | W | M,T,T7 | NU | NJ | NUP | — | — | 41.5 | 41.5 | 44 | 48 | 53 | 72 | — | — | 1.5 | 1 | 0.545 |
| NU 2307 E* | M | T, T7 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| NU 2307 E | M | T, T7 | NU | NJ | NUP | — | — | 43 | 41.5 | 44 | 48 | 53 | 72 | — | — | 1.5 | 1 | 0.711 |
| NU 407 | W | — | NU | NJ | — | N | NF | 43 | 43 | 51 | 55 | 61 | 92 | 92 | 85 | 1.5 | 1.5 | 1.01 |
| NU 1008 | (M) | — | NU | NJ | NUP | N | — | 45 | 44 | 46 | 49 | — | 63 | 64 | 62 | 1 | 0.6 | 0.223 |
| N 208 | W | M | — | — | — | N | NF | 46.5 | — | — | — | — | — | 73.5 | 72 | 1 | 1 | 0.375 |
| NU 208 E* | W | M,T,T7 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| NU 208 E | W | M,T,T7 | NU | NJ | NUP | — | — | 46.5 | 46.5 | 48 | 52 | 56 | 73.5 | — | — | 1 | 1 | 0.379 |
| NU 2208 E* | M | T, T7 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| NU 2208 E | M | T, T7 | NU | NJ | NUP | — | — | 46.5 | 46.5 | 48 | 52 | 56 | 73.5 | — | — | 1 | 1 | 0.480 |
| N 308 | W | M | — | — | — | N | NF | 48 | — | — | — | — | — | 82 | 79 | 1.5 | 1.5 | 0.649 |
| NU 308 E* | W | M,T,T7 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| NU 308 E | W | M,T,T7 | NU | NJ | NUP | — | — | 48 | 48 | 50 | 55 | 60 | 82 | — | — | 1.5 | 1.5 | 0.747 |
| NU 2308 E* | M | T, T7 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| NU 2308 ET | M | T, T7 | NU | NJ | NUP | — | — | 48 | 48 | 50 | 55 | 60 | 82 | — | — | 1.5 | 1.5 | 0.933 |
| NU 408 | W | — | NU | NJ | NUP | N | NF | 49 | 49 | 56 | 60 | 67 | 101 | 101 | 94 | 2 | 2 | 1.28 |

**Notes** (3) If axial loads are applied, increase $d_a$ and reduce $D_a$ from the values listed above.
(4) $d_b$ (max.) are values for adjusting rings for NU, NJ Types.
(5) The limiting speeds (mechanical) in the bearing tables are the value for the standard cage type.

**Remark** The bearings denoted by an asterisk (*) are NSKHPS Cylindrical roller bearings.

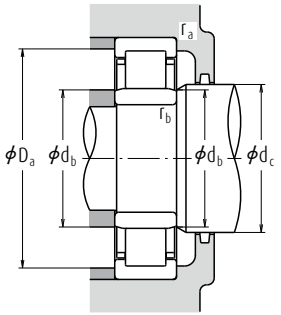
## Bore Diameter 45 – 50 mm

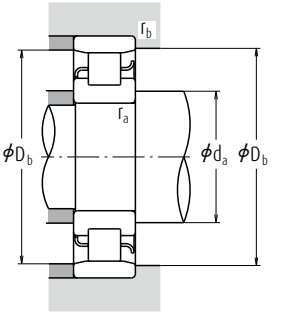


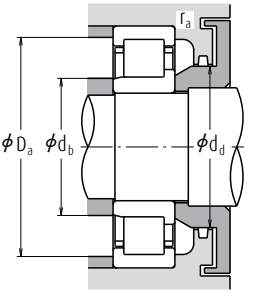

NU NJ NUP N NF

| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Speeds (min⁻¹) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Thermal Reference Speed | Limiting Speeds | |
| d | D | B | r min. | r1 min. | $F_W$ | $E_W$ | $C_r$ | $C_{0r}$ | | Mechanical (5) | Grease |
| **45** | 75 | 16 | 1.0 | 0.6 | 52.5 | 67.5 | 32 500 | 35 500 | 9 500 | – | 9 300 |
| | 85 | 19 | 1.1 | 1.1 | – | 75 | 46 000 | 47 000 | 9 500 | – | 6 300 |
| | 85 | 19 | 1.1 | 1.1 | 54.5 | – | 72 500 | 66 500 | 8 500 | 10 000 | 6 700 |
| | 85 | 19 | 1.1 | 1.1 | 54.5 | – | 63 000 | 66 500 | 8 500 | 10 000 | 6 700 |
| | 85 | 23 | 1.1 | 1.1 | 54.5 | – | 87 500 | 84 500 | 8 500 | 12 000 | 6 700 |
| | 85 | 23 | 1.1 | 1.1 | 54.5 | – | 76 000 | 84 500 | 8 500 | 12 000 | 6 700 |
| | 100 | 25 | 1.5 | 1.5 | – | 86.5 | 79 000 | 77 500 | 7 500 | – | 5 000 |
| | 100 | 25 | 1.5 | 1.5 | 58.5 | – | 112 000 | 98 500 | 7 100 | 9 000 | 6 000 |
| | 100 | 25 | 1.5 | 1.5 | 58.5 | – | 97 500 | 98 500 | 7 100 | 9 000 | 6 000 |
| | 100 | 36 | 1.5 | 1.5 | 58.5 | – | 158 000 | 153 000 | 7 100 | 11 000 | 5 300 |
| | 100 | 36 | 1.5 | 1.5 | 58.5 | – | 137 000 | 153 000 | 7 100 | 11 000 | 5 300 |
| | 120 | 29 | 2.0 | 2.0 | 64.5 | 100.5 | 107 000 | 102 000 | 6 300 | – | 4 300 |
| **50** | 80 | 16 | 1.0 | 0.6 | 57.5 | 72.5 | 32 000 | 36 000 | 8 500 | – | 8 000 |
| | 90 | 20 | 1.1 | 1.1 | – | 80.4 | 48 000 | 51 000 | 8 500 | – | 5 600 |
| | 90 | 20 | 1.1 | 1.1 | 59.5 | – | 79 500 | 76 500 | 8 000 | 9 000 | 6 300 |
| | 90 | 20 | 1.1 | 1.1 | 59.5 | – | 69 000 | 76 500 | 8 000 | 9 000 | 6 300 |
| | 90 | 23 | 1.1 | 1.1 | 59.5 | – | 96 000 | 97 000 | 7 500 | 11 000 | 6 300 |
| | 90 | 23 | 1.1 | 1.1 | 59.5 | – | 83 500 | 97 000 | 7 500 | 11 000 | 6 300 |
| | 110 | 27 | 2.0 | 2.0 | – | 95 | 87 000 | 86 000 | 7 100 | – | 4 500 |
| | 110 | 27 | 2.0 | 2.0 | 65.0 | – | 127 000 | 113 000 | 6 700 | 8 000 | 5 000 |
| | 110 | 27 | 2.0 | 2.0 | 65.0 | – | 110 000 | 113 000 | 6 700 | 8 000 | 5 000 |
| | 110 | 40 | 2.0 | 2.0 | 65.0 | – | 187 000 | 187 000 | 6 700 | 10 000 | 5 000 |
| | 110 | 40 | 2.0 | 2.0 | 65.0 | – | 163 000 | 187 000 | 6 700 | 10 000 | 5 000 |
| | 130 | 31 | 2.1 | 2.1 | – | 110.8 | 139 000 | 136 000 | 5 600 | – | 4 000 |
| | 130 | 31 | 2.1 | 2.1 | 70.8 | 110.8 | 129 000 | 124 000 | 5 600 | – | 4 000 |

**Notes** (1) (M) in the column of cage symbols are usually omitted from the bearing number.
(2) When L-Shaped thrust collars (See section for L-Shaped Thrust Collars starting on page **B174**) are used, the bearings become the NH type.



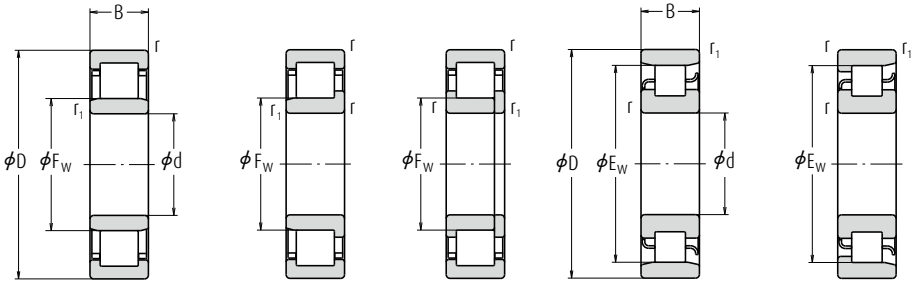




| Bearing Numbers | | | | | | | | Abutment and Fillet Dimensions (mm) | | | | | | | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cage symbol (1) Standard option | | NU | (2) NJ | NUP | N | NF | $d_a$(3) min. | $d_b$ min. | $d_b$(4) max. | $d_c$ min. | $d_d$ min. | $D_a$(3) max. | $D_b$ max. | $D_b$ min. | $r_a$ max. | $r_b$ max. | approx. |
| **NU 1009** | **(M)** | **—** | **NU** | **—** | **—** | **N** | **NF** | 50 | 49 | 51 | 54 | — | 70 | 71 | 68 | 1 | 0.6 | 0.279 |
| **N 209** | **W** | **M** | **—** | **—** | **—** | **N** | **NF** | 51.5 | — | — | — | — | — | 78.5 | 77 | 1 | 1 | 0.429 |
| **NU 209 E*** | **W** | **M,T,T7** | **—** | **—** | **—** | **—** | **—** | — | — | — | — | — | — | — | — | — | — | — |
| **NU 209 E** | **W** | **M,T,T7** | **NU** | **NJ** | **NUP** | **—** | **—** | 51.5 | 51.5 | 52 | 57 | 61 | 78.5 | — | — | 1 | 1 | 0.438 |
| **NU 2209 E*** | **M** | **T, T7** | **—** | **—** | **—** | **—** | **—** | — | — | — | — | — | — | — | — | — | — | — |
| **NU 2209 E** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | **—** | **—** | 51.5 | 51.5 | 52 | 57 | 61 | 78.5 | — | — | 1 | 1 | 0.521 |
| **N 309** | **W** | **M** | **—** | **—** | **—** | **N** | **NF** | 53 | — | — | — | — | — | 92 | 77 | 1.5 | 1.5 | 0.869 |
| **NU 309 E*** | **W** | **M,T,T7** | **—** | **—** | **—** | **—** | **—** | — | — | — | — | — | — | — | — | — | — | — |
| **NU 309 E** | **W** | **M,T,T7** | **NU** | **NJ** | **NUP** | **—** | **—** | 53 | 53 | 56 | 60 | 66 | 92 | — | — | 1.5 | 1.5 | 1.01 |
| **NU 2309 E*** | **M** | **T, T7** | **—** | **—** | **—** | **—** | **—** | — | — | — | — | — | — | — | — | — | — | — |
| **NU 2309 E** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | **—** | **—** | 53 | 53 | 56 | 60 | 66 | 92 | — | — | 1.5 | 1.5 | 1.28 |
| **NU 409** | **W** | **—** | **NU** | **NJ** | **NUP** | **N** | **NF** | 54 | 54 | 62 | 66 | 74 | 111 | 111 | 103 | 2 | 2 | 1.62 |
| **NU 1010** | **(M)** | **—** | **NU** | **NJ** | **NUP** | **N** | **—** | 55 | 54 | 56 | 59 | — | 75 | 76 | 73 | 1 | 0.6 | 0.301 |
| **N 210** | **W** | **M** | **—** | **—** | **—** | **N** | **NF** | 56.5 | — | — | — | — | — | 83.5 | 82 | 1 | 1 | 0.483 |
| **NU 210 E*** | **W** | **M,T,T7** | **—** | **—** | **—** | **—** | **—** | — | — | — | — | — | — | — | — | — | — | — |
| **NU 210 E** | **W** | **M,T,T7** | **NU** | **NJ** | **NUP** | **—** | **—** | 56.5 | 56.5 | 57 | 62 | 67 | 83.5 | — | — | 1 | 1 | 0.50 |
| **NU 2210 E*** | **M** | **T, T7** | **—** | **—** | **—** | **—** | **—** | — | — | — | — | — | — | — | — | — | — | — |
| **NU 2210 E** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | **—** | **—** | 56.5 | 56.5 | 57 | 62 | 67 | 83.5 | — | — | 1 | 1 | 0.562 |
| **N 310** | **W** | **M** | **—** | **—** | **—** | **N** | **NF** | 59 | — | — | — | — | — | 101 | 97 | 2 | 2 | 1.11 |
| **NU 310 E*** | **W** | **M,T,T7** | **—** | **—** | **—** | **—** | **—** | — | — | — | — | — | — | — | — | — | — | — |
| **NU 310 E** | **W** | **M,T,T7** | **NU** | **NJ** | **NUP** | **—** | **—** | 59 | 59 | 63 | 67 | 73 | 101 | — | — | 2 | 2 | 1.3 |
| **NU 2310 E*** | **M** | **T, T7** | **—** | **—** | **—** | **—** | **—** | — | — | — | — | — | — | — | — | — | — | — |
| **NU 2310 E** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | **—** | **—** | 59 | 59 | 63 | 67 | 73 | 101 | — | — | 2 | 2 | 1.7 |
| **N 410** | **W** | **M** | **—** | **—** | **—** | **N** | **NF** | 65 | — | — | — | — | — | 117 | 113 | 2 | 2 | 2.0 |
| **NU 410** | **W** | **M** | **NU** | **NJ** | **NUP** | **—** | **—** | 61 | 61 | 68 | 73 | 81 | 119 | 119 | 113.3 | 2 | 2 | 1.99 |

**Notes** (3) If axial loads are applied, increase $d_a$ and reduce $D_a$ from the values listed above.
(4) $d_b$ (max.) are values for adjusting rings for NU, NJ Types.
(5) The limiting speeds(mechanical) in the bearing tables are the value for the standard cage type.

**Remark** The bearings denoted by an asterisk (*) are NSKHPS Cylindrical roller bearings.

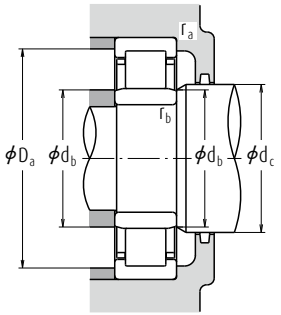
## Bore Diameter 55 – 60 mm

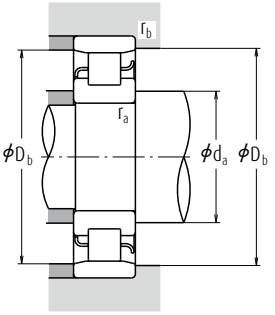


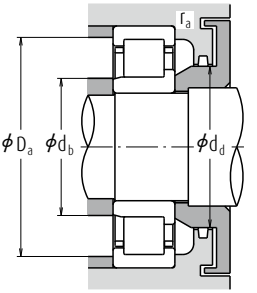

NU NJ NUP N NF

| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Speeds (min⁻¹) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Thermal Reference Speed | Limiting Speeds | |
| d | D | B | r min. | r1 min. | $F_W$ | $E_W$ | $C_r$ | $C_{0r}$ | | Mechanical (5) | Grease |
| **55** | 90 | 18 | 1.1 | 1.0 | 64.5 | 80.5 | 37 500 | 44 000 | 8 000 | – | 7 500 |
| | 100 | 21 | 1.5 | 1.1 | – | 88.5 | 58 000 | 62 500 | 7 500 | – | 5 300 |
| | 100 | 21 | 1.5 | 1.1 | 66.0 | – | 99 000 | 98 500 | 6 700 | 8 500 | 5 600 |
| | 100 | 21 | 1.5 | 1.1 | 66.0 | – | 86 500 | 98 500 | 6 700 | 8 500 | 5 600 |
| | 100 | 25 | 1.5 | 1.1 | 66.0 | – | 117 000 | 122 000 | 6 700 | 10 000 | 5 600 |
| | 100 | 25 | 1.5 | 1.1 | 66.0 | – | 101 000 | 122 000 | 6 700 | 10 000 | 5 600 |
| | 120 | 29 | 2.0 | 2.0 | – | 104.5 | 111 000 | 111 000 | 6 300 | – | 4 000 |
| | 120 | 29 | 2.0 | 2.0 | 70.5 | – | 158 000 | 143 000 | 6 000 | 7 500 | 4 500 |
| | 120 | 29 | 2.0 | 2.0 | 70.5 | – | 137 000 | 143 000 | 6 000 | 7 500 | 4 500 |
| | 120 | 43 | 2.0 | 2.0 | 70.5 | – | 231 000 | 233 000 | 6 000 | 9 000 | 4 500 |
| | 120 | 43 | 2.0 | 2.0 | 70.5 | – | 201 000 | 233 000 | 6 000 | 9 000 | 4 500 |
| | 140 | 33 | 2.1 | 2.1 | 77.2 | 117.2 | 139 000 | 138 000 | 5 300 | – | 3 800 |
| **60** | 95 | 18 | 1.1 | 1.0 | 69.5 | 85.5 | 40 000 | 48 500 | 7 500 | – | 6 700 |
| | 110 | 22 | 1.5 | 1.5 | – | 97.5 | 68 500 | 75 000 | 7 100 | – | 4 800 |
| | 110 | 22 | 1.5 | 1.5 | 72.0 | – | 112 000 | 107 000 | 6 300 | 7 500 | 5 300 |
| | 110 | 22 | 1.5 | 1.5 | 72.0 | – | 97 500 | 107 000 | 6 300 | 7 500 | 5 300 |
| | 110 | 28 | 1.5 | 1.5 | 72.0 | – | 151 000 | 157 000 | 6 300 | 9 500 | 5 300 |
| | 110 | 28 | 1.5 | 1.5 | 72.0 | – | 131 000 | 157 000 | 6 300 | 9 500 | 5 300 |
| | 130 | 31 | 2.1 | 2.1 | – | 113 | 124 000 | 126 000 | 6 000 | – | 3 800 |
| | 130 | 31 | 2.1 | 2.1 | 77.0 | – | 124 000 | 126 000 | 6 000 | – | 3 800 |
| | 130 | 31 | 2.1 | 2.1 | 77.0 | – | 169 000 | 157 000 | 5 600 | 9 500 | 4 800 |
| | 130 | 31 | 2.1 | 2.1 | 77.0 | – | 150 000 | 157 000 | 5 600 | 9 500 | 4 800 |
| | 130 | 46 | 2.1 | 2.1 | 77.0 | – | 251 000 | 262 000 | 5 600 | 8 500 | 4 300 |
| | 130 | 46 | 2.1 | 2.1 | 77.0 | – | 222 000 | 262 000 | 5 600 | 8 500 | 4 300 |
| | 150 | 35 | 2.1 | 2.1 | 83.0 | 127 | 167 000 | 168 000 | 5 000 | – | 3 400 |

**Notes** (1) (M) in the column of cage symbols are usually omitted from the bearing number.
(2) When L-Shaped thrust collars (See section for L-Shaped Thrust Collars starting on page **B174**) are used, the bearings become the NH type.



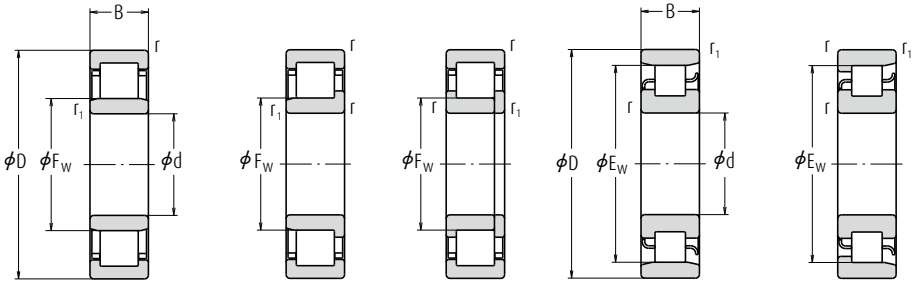




| Bearing Numbers | | | | | | | | Abutment and Fillet Dimensions (mm) | | | | | | | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cage symbol (1) Standard option | | NU | (2) NJ | NUP | N | NF | $d_a$(3) min. | $d_b$ min. | $d_b$(4) max. | $d_c$ min. | $d_d$ min. | $D_a$(3) max. | $D_b$ max. | $D_b$ min. | $r_a$ max. | $r_b$ max. | approx. |
| **NU 1011** | **(M)** | **—** | **NU** | **NJ** | **—** | **N** | **—** | 61.5 | 60 | 63 | 66 | — | 83.5 | 85 | 82 | 1 | 1 | 0.445 |
| **N 211** | **W** | **M** | **—** | **—** | **—** | **N** | **NF** | 63 | — | — | — | — | — | 93.5 | 91 | 1.5 | 1 | 0.634 |
| **NU 211 E*** | **W** | **M,T,T7** | **—** | **—** | **—** | **—** | **—** | — | — | — | — | — | — | — | — | — | — | — |
| **NU 211 E** | **W** | **M,T,T7** | **NU** | **NJ** | **NUP** | **—** | **—** | 63 | 61.5 | 64 | 68 | 73 | 92 | — | — | 1.5 | 1 | 0.669 |
| **NU 2211 E*** | **M** | **T, T7** | **—** | **—** | **—** | **—** | **—** | — | — | — | — | — | — | — | — | — | — | — |
| **NU 2211 ET** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | **—** | **—** | 63 | 61.5 | 64 | 68 | 73 | 92 | — | — | 1.5 | 1 | 0.783 |
| **N 311** | **W** | **M** | **—** | **—** | **—** | **N** | **NF** | 64 | — | — | — | — | — | 111 | 107 | 2 | 2 | 1.42 |
| **NU 311 E*** | **W** | **M,T,T7** | **—** | **—** | **—** | **—** | **—** | — | — | — | — | — | — | — | — | — | — | — |
| **NU 311 E** | **W** | **M,T,T7** | **NU** | **NJ** | **NUP** | **—** | **—** | 64 | 64 | 68 | 72 | 80 | 111 | — | — | 2 | 2 | 1.64 |
| **NU 2311 E*** | **M** | **T, T7** | **—** | **—** | **—** | **—** | **—** | — | — | — | — | — | — | — | — | — | — | — |
| **NU 2311 E** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | **—** | **—** | 64 | 64 | 68 | 72 | 80 | 111 | — | — | 2 | 2 | 2.18 |
| **NU 411** | **W** | **—** | **NU** | **NJ** | **NUP** | **N** | **NF** | 66 | 66 | 75 | 79 | 87 | 129 | 129 | 119 | 2 | 2 | 2.5 |
| **NU 1012** | **(M)** | **—** | **NU** | **NJ** | **—** | **N** | **NF** | 66.5 | 65 | 68 | 71 | — | 88.5 | 90 | 87 | 1 | 1 | 0.474 |
| **N 212** | **W** | **M** | **—** | **—** | **—** | **N** | **NF** | 68 | — | — | — | — | — | 102 | 100 | 1.5 | 1.5 | 0.823 |
| **NU 212 E*** | **W** | **M,T,T7** | **—** | **—** | **—** | **—** | **—** | — | — | — | — | — | — | — | — | — | — | — |
| **NU 212 E** | **W** | **M,T,T7** | **NU** | **NJ** | **NUP** | **—** | **—** | 68 | 68 | 70 | 75 | 80 | 102 | — | — | 1.5 | 1.5 | 0.824 |
| **NU 2212 E*** | **M** | **T, T7** | **—** | **—** | **—** | **—** | **—** | — | — | — | — | — | — | — | — | — | — | — |
| **NU 2212 E** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | **—** | **—** | 68 | 68 | 70 | 75 | 80 | 102 | — | — | 1.5 | 1.5 | 1.06 |
| **N 312** | **W** | **M** | **—** | **—** | **—** | **N** | **NF** | 71 | — | — | — | — | — | 119 | 115 | 2 | 2 | 1.78 |
| **NU 312** | **W** | **M** | **NU** | **NJ** | **NUP** | **—** | **—** | 71 | 71 | 75 | 79 | 86 | 119 | — | — | 2 | 2 | 1.82 |
| **NU 312 E*** | **M** | **T, T7** | **—** | **—** | **—** | **—** | **—** | — | — | — | — | — | — | — | — | — | — | — |
| **NU 312 E** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | **—** | **—** | 71 | 71 | 75 | 79 | 86 | 119 | — | — | 2 | 2 | 2.06 |
| **NU 2312 E*** | **M** | **T, T7** | **—** | **—** | **—** | **—** | **—** | — | — | — | — | — | — | — | — | — | — | — |
| **NU 2312 ET** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | **—** | **—** | 71 | 71 | 75 | 79 | 86 | 119 | — | — | 2 | 2 | 2.7 |
| **NU 412** | **W** | **M** | **NU** | **NJ** | **NUP** | **N** | **NF** | 71 | 71 | 80 | 85 | 94 | 139 | 139 | 130 | 2 | 2 | 3.04 |

**Notes** (3) If axial loads are applied, increase $d_a$ and reduce $D_a$ from the values listed above.
(4) $d_b$ (max.) are values for adjusting rings for NU, NJ Types.
(5) The limiting speeds (mechanical) in the bearing tables are the value for the standard cage type.

**Remark** The bearings denoted by an asterisk (*) are NSKHPS Cylindrical roller bearings.

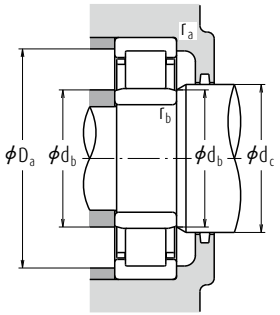
## Bore Diameter 65 – 70 mm

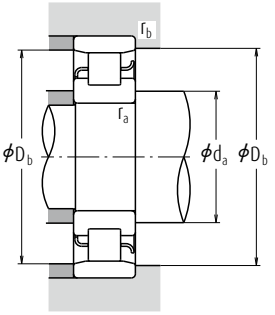


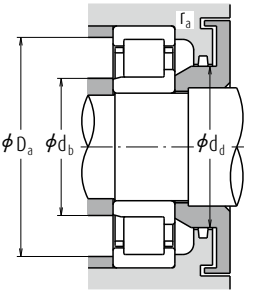

NU NJ NUP N NF

| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Speeds (min⁻¹) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Thermal Reference Speed | Limiting Speeds | |
| d | D | B | r min. | r1 min. | $F_w$ | $E_w$ | $C_r$ | $C_{0r}$ | | Mechanical (5) | Grease |
| **65** | 100 | 18 | 1.1 | 1.0 | 74.5 | 90.5 | 41 000 | 51 000 | 6 700 | – | 6 300 |
| | 120 | 23 | 1.5 | 1.5 | – | 105.6 | 84 000 | 94 500 | 6 300 | – | 4 300 |
| | 120 | 23 | 1.5 | 1.5 | 78.5 | – | 124 000 | 119 000 | 6 000 | 7 100 | 4 800 |
| | 120 | 23 | 1.5 | 1.5 | 78.5 | – | 108 000 | 119 000 | 6 000 | 7 100 | 4 800 |
| | 120 | 31 | 1.5 | 1.5 | 78.5 | – | 171 000 | 181 000 | 6 000 | 8 500 | 4 800 |
| | 120 | 31 | 1.5 | 1.5 | 78.5 | – | 149 000 | 181 000 | 6 000 | 8 500 | 4 800 |
| | 140 | 33 | 2.1 | 2.1 | – | 121.5 | 135 000 | 139 000 | 5 600 | – | 3 600 |
| | 140 | 33 | 2.1 | 2.1 | 83.5 | – | 135 000 | 139 000 | 5 600 | – | 3 600 |
| | 140 | 33 | 2.1 | 2.1 | 82.5 | – | 204 000 | 191 000 | 5 300 | 8 500 | 4 300 |
| | 140 | 33 | 2.1 | 2.1 | 82.5 | – | 181 000 | 191 000 | 5 300 | 8 500 | 4 300 |
| | 140 | 48 | 2.1 | 2.1 | 82.5 | – | 263 000 | 265 000 | 5 600 | 7 500 | 3 800 |
| | 140 | 48 | 2.1 | 2.1 | 82.5 | – | 233 000 | 265 000 | 5 600 | 7 500 | 3 800 |
| | 160 | 37 | 2.1 | 2.1 | – | 135.3 | 195 000 | 203 000 | 4 500 | – | 4 000 |
| | 160 | 37 | 2.1 | 2.1 | 89.3 | – | 182 000 | 186 000 | 4 800 | – | 3 200 |
| **70** | 110 | 20 | 1.1 | 1.0 | 80.0 | 100 | 58 500 | 70 500 | 6 300 | – | 6 000 |
| | 125 | 24 | 1.5 | 1.5 | – | 110.5 | 83 500 | 95 000 | 6 300 | – | 4 000 |
| | 125 | 24 | 1.5 | 1.5 | 83.5 | – | 136 000 | 137 000 | 5 600 | 9 000 | 5 000 |
| | 125 | 24 | 1.5 | 1.5 | 83.5 | – | 119 000 | 137 000 | 5 600 | 9 000 | 5 000 |
| | 125 | 31 | 1.5 | 1.5 | 83.5 | – | 179 000 | 194 000 | 5 600 | 8 000 | 4 500 |
| | 125 | 31 | 1.5 | 1.5 | 83.5 | – | 156 000 | 194 000 | 5 600 | 8 000 | 4 500 |
| | 150 | 35 | 2.1 | 2.1 | – | 130 | 149 000 | 156 000 | 5 600 | – | 3 200 |
| | 150 | 35 | 2.1 | 2.1 | 89.0 | – | 231 000 | 222 000 | 4 800 | 8 000 | 3 200 |
| | 150 | 35 | 2.1 | 2.1 | 90.0 | – | 231 000 | 222 000 | 4 800 | 8 000 | 4 000 |
| | 150 | 35 | 2.1 | 2.1 | 89.0 | – | 205 000 | 222 000 | 4 800 | 8 000 | 4 000 |
| | 150 | 51 | 2.1 | 2.1 | 89.0 | – | 310 000 | 325 000 | 5 000 | 7 100 | 3 600 |
| | 150 | 51 | 2.1 | 2.1 | 89.0 | – | 274 000 | 325 000 | 5 000 | 7 100 | 3 600 |
| | 180 | 42 | 3.0 | 3.0 | 100.0 | 152 | 228 000 | 236 000 | 4 500 | – | 2 800 |

**Notes** (1) (M) in the column of cage symbols are usually omitted from the bearing number.
(2) When L-Shaped thrust collars (See section for L-Shaped Thrust Collars starting on page **B174**) are used, the bearings become the NH type.



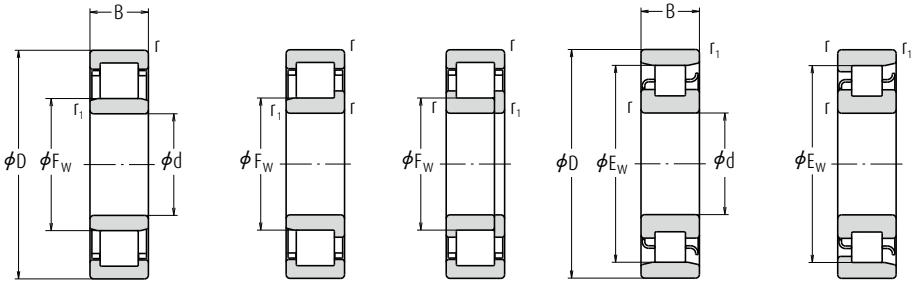




| Bearing Numbers | | | | | | | | Abutment and Fillet Dimensions (mm) | | | | | | | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cage symbol (1) Standard option | | NU | (2) NJ | NUP | N | NF | $d_a$(3) min. | $d_b$ min. | $d_b$(4) max. | $d_c$ min. | $d_d$ min. | $D_a$(3) max. | $D_b$ max. | $D_b$ min. | $r_a$ max. | $r_b$ max. | approx. |
| NU 1013 | (M) | — | NU | NJ | — | N | NF | 71.5 | 70 | 73 | 76 | — | 93.5 | 95 | 92 | 1 | 1 | 0.504 |
| N 213 | W | M | — | — | — | N | NF | 73 | — | — | — | — | — | 112 | 108 | 1.5 | 1.5 | 1.05 |
| NU 213 E* | W | M,T,T7 | NU | NJ | NUP | — | — | 73 | 73 | 76 | 81 | 87 | 112 | — | — | 1.5 | 1.5 | 1.05 |
| NU 213 E | W | M,T,T7 | NU | NJ | NUP | — | — | 73 | 73 | 76 | 81 | 87 | 112 | — | — | 1.5 | 1.5 | 1.05 |
| NU 2213 E* | M | T,T7 | NU | NJ | NUP | — | — | 73 | 73 | 76 | 81 | 87 | 112 | — | — | 1.5 | 1.5 | 1.41 |
| NU 2213 E | M | T,T7 | NU | NJ | NUP | — | — | 73 | 73 | 76 | 81 | 87 | 112 | — | — | 1.5 | 1.5 | 1.41 |
| N 313 | W | M | — | — | — | N | NF | 76 | — | — | — | — | — | 129 | 125 | 2 | 2 | 2.17 |
| NU 313 | W | M | NU | NJ | NUP | — | — | 76 | 76 | 81 | 85 | 93 | 129 | — | — | 2 | 2 | 2.23 |
| NU 313 E* | M | T,T7 | NU | NJ | NUP | — | — | 76 | 76 | 80 | 85 | 93 | 129 | — | — | 2 | 2 | 2.56 |
| NU 313 E | M | T,T7 | NU | NJ | NUP | — | — | 76 | 76 | 80 | 85 | 93 | 129 | — | — | 2 | 2 | 2.56 |
| NU 2313 E* | M | T,T7 | NU | NJ | NUP | — | — | 76 | 76 | 80 | 85 | 93 | 129 | — | — | 2 | 2 | 3.16 |
| NU 2313 E | M | T,T7 | NU | NJ | NUP | — | — | 76 | 76 | 80 | 85 | 93 | 129 | — | — | 2 | 2 | 3.16 |
| N 413 | M | — | — | — | — | N | NF | 76 | — | — | — | — | — | 149 | 138.8 | 2 | 2 | 3.63 |
| NU 413 | W | M | NU | NJ | — | — | — | 76 | 76 | 86 | 91 | 100 | 149 | — | — | 2 | 2 | 3.63 |
| NU 1014 | (M) | — | NU | NJ | NUP | N | NF | 76.5 | 75 | 79 | 82 | — | 103.5 | 105 | 101 | 1 | 1 | 0.693 |
| N 214 | W | M | — | — | — | N | NF | 78 | — | — | — | — | — | 117 | 113 | 1.5 | 1.5 | 1.14 |
| NU 214 E* | M | T,T7 | NU | NJ | NUP | — | — | 78 | 78 | 81 | 86 | 92 | 117 | — | — | 1.5 | 1.5 | 1.29 |
| NU 214 E | M | T,T7 | NU | NJ | NUP | — | — | 78 | 78 | 81 | 86 | 92 | 117 | — | — | 1.5 | 1.5 | 1.29 |
| NU 2214 E* | M | T,T7 | NU | NJ | NUP | — | — | 78 | 78 | 81 | 86 | 92 | 117 | — | — | 1.5 | 1.5 | 1.14 |
| NU 2214 E | M | T,T7 | NU | NJ | NUP | — | — | 78 | 78 | 81 | 86 | 92 | 117 | — | — | 1.5 | 1.5 | 1.49 |
| N 314 | W | M | — | — | — | N | NF | 81 | — | — | — | — | — | 139 | 133.5 | 2 | 2 | 2.67 |
| NU 314 | W | M | NU | NJ | NUP | — | — | 81 | 81 | 87 | 92 | 100 | 139 | — | — | 2 | 2 | 2.75 |
| NU 314 E* | M | T, T7 | NU | NJ | NUP | — | — | 81 | 81 | 87 | 92 | 100 | 139 | — | — | 2 | 2 | 3.09 |
| NU 314 E | M | T, T7 | NU | NJ | NUP | — | — | 81 | 81 | 86 | 92 | 100 | 139 | — | — | 2 | 2 | 3.09 |
| NU 2314 E* | M | T, T7 | NU | NJ | NUP | — | — | 81 | 81 | 86 | 92 | 100 | 139 | — | — | 2 | 2 | 3.92 |
| NU 2314 E | M | T, T7 | NU | NJ | NUP | — | — | 81 | 81 | 86 | 92 | 100 | 139 | — | — | 2 | 2 | 3.92 |
| NU 414 | W | M | NU | NJ | NUP | N | NF | 83 | 83 | 97 | 102 | 112 | 167 | 167 | 155 | 2.5 | 2.5 | 5.28 |

**Notes** (3) If axial loads are applied, increase $d_a$ and reduce $D_a$ from the values listed above.
(4) $d_b$ (max.) are values for adjusting rings for NU, NJ Types.
(5) The limiting speeds(mechanical) in the bearing tables are the value for the standard cage type.

**Remark** The bearings denoted by an asterisk (*) are NSKHPS Cylindrical roller bearings.

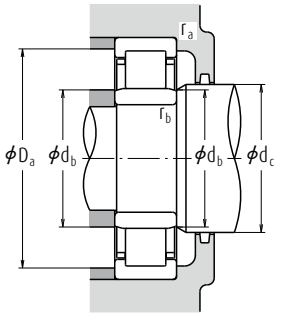
## Bore Diameter 75 mm

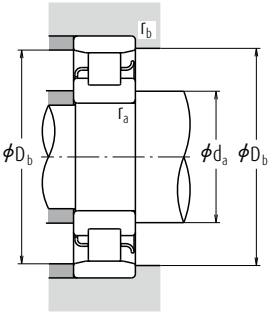


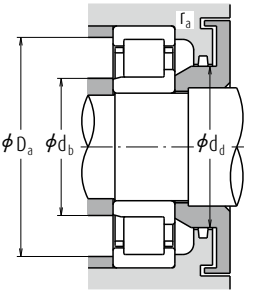

NU NJ NUP N NF

| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Speeds (min⁻¹) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Thermal Reference Speed | Limiting Speeds | |
| d | D | B | r min. | r1 min. | $F_W$ | $E_W$ | $C_r$ | $C_{0r}$ | | Mechanical (5) | Grease |
| **75** | 115 | 20 | 1.1 | 1.0 | 85.0 | 105 | 60 000 | 74 500 | 6 000 | – | 5 600 |
| | 130 | 25 | 1.5 | 1.5 | – | 116.5 | 96 500 | 111 000 | 6 000 | – | 3 800 |
| | 130 | 25 | 1.5 | 1.5 | 88.5 | – | 150 000 | 156 000 | 5 300 | 8 500 | 4 800 |
| | 130 | 25 | 1.5 | 1.5 | 88.5 | – | 130 000 | 156 000 | 5 300 | 8 500 | 4 800 |
| | 130 | 31 | 1.5 | 1.5 | 88.5 | – | 186 000 | 207 000 | 5 300 | 7 500 | 4 300 |
| | 130 | 31 | 1.5 | 1.5 | 88.5 | – | 162 000 | 207 000 | 5 300 | 7 500 | 4 300 |
| | 160 | 37 | 2.1 | 2.1 | – | 139.5 | 179 000 | 189 000 | 5 000 | – | 3 000 |
| | 160 | 37 | 2.1 | 2.1 | 95.5 | – | 179 000 | 189 000 | 5 000 | – | 3 000 |
| | 160 | 37 | 2.1 | 2.1 | 95.0 | – | 271 000 | 263 000 | 4 500 | 7 500 | 3 800 |
| | 160 | 37 | 2.1 | 2.1 | 95.0 | – | 240 000 | 263 000 | 4 500 | 7 500 | 3 800 |
| | 160 | 55 | 2.1 | 2.1 | 95.0 | – | 370 000 | 395 000 | 4 800 | 6 700 | 3 400 |
| | 160 | 55 | 2.1 | 2.1 | 95.0 | – | 330 000 | 395 000 | 4 800 | 6 700 | 3 400 |
| | 190 | 45 | 3.0 | 3.0 | 104.5 | 160.5 | 262 000 | 274 000 | 4 300 | – | 2 600 |

**Notes** (1) (M) in the column of cage symbols are usually omitted from the bearing number.
(2) When L-Shaped thrust collars (See section for L-Shaped Thrust Collars starting on page **B174**) are used, the bearings become the NH type.



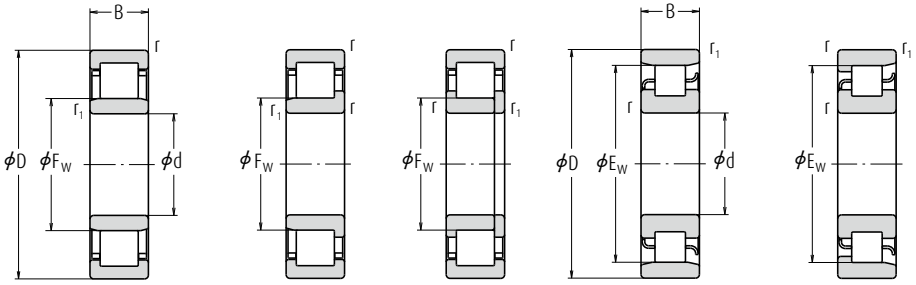




| Bearing Numbers | | | | | | | | Abutment and Fillet Dimensions (mm) | | | | | | | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cage symbol (1) Standard option | | NU | (2) NJ | NUP | N | NF | $d_a$(3) min. | $d_b$ min. | $d_b$(4) max. | $d_c$ min. | $d_d$ min. | $D_a$(3) max. | $D_b$ max. | $D_b$ min. | $r_a$ max. | $r_b$ max. | approx. |
| **NU 1015** | **(M)** | — | **NU** | — | — | **N** | **NF** | 81.5 | 80 | 83 | 87 | — | 108.5 | 110 | 106 | 1 | 1 | 0.731 |
| **N 215** | **W** | **M** | — | — | — | **N** | **NF** | 83 | — | — | — | — | — | 122 | 119 | 1.5 | 1.5 | 1.23 |
| **NU 215 E*** | **M** | **T, T7** | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| **NU 215 E** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | — | — | 83 | 83 | 86 | 90 | 96 | 122 | — | — | 1.5 | 1.5 | 1.44 |
| **NU 2215 E*** | **M** | **T, T7** | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| **NU 2215 E** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | — | — | 83 | 83 | 86 | 90 | 96 | 122 | — | — | 1.5 | 1.5 | 1.57 |
| **N 315** | **W** | **M** | — | — | — | **N** | **NF** | 86 | — | — | — | — | — | 149 | 143 | 2 | 2 | 3.2 |
| **NU 315** | **W** | **T, T7** | **NU** | **NJ** | **NUP** | — | — | 86 | 86 | 93 | 97 | 106 | 149 | — | — | 2 | 2 | 3.26 |
| **NU 315 E*** | **M** | **T, T7** | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| **NU 315 E** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | — | — | 86 | 86 | 92 | 97 | 106 | 149 | — | — | 2 | 2 | 3.73 |
| **NU 2315 E*** | **M** | **T, T7** | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| **NU 2315 E** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | — | — | 86 | 86 | 92 | 97 | 106 | 149 | — | — | 2 | 2 | 4.86 |
| **NU 415** | **W** | **M** | **NU** | **NJ** | — | **N** | **NF** | 88 | 88 | 102 | 107 | 118 | 177 | 177 | 164 | 2.5 | 2.5 | 6.27 |

**Notes** (3) If axial loads are applied, increase $d_a$ and reduce $D_a$ from the values listed above.
(4) $d_b$ (max.) are values for adjusting rings for NU, NJ Types.
(5) The limiting speeds (mechanical) in the bearing tables are the value for the standard cage type.

**Remark** The bearings denoted by an asterisk (*) are NSKHPS Cylindrical roller bearings.

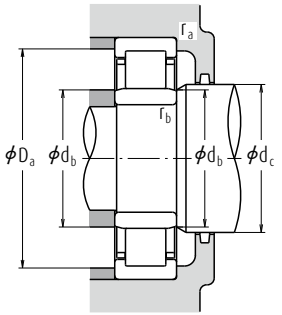
## Bore Diameter 80 – 90 mm

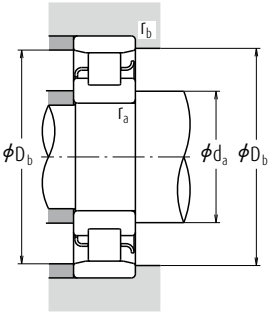


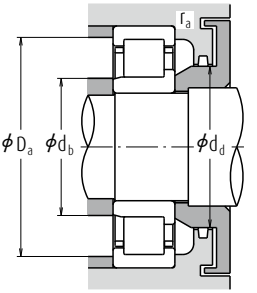

NU NJ NUP N NF

| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Speeds (min⁻¹) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Thermal Reference Speed | Limiting Speeds | |
| d | D | B | r min. | r1 min. | $F_W$ | $E_W$ | $C_r$ | $C_{0r}$ | | Mechanical (5) | Grease |
| **80** | 125 | 22 | 1.1 | 1.0 | 91.5 | 113.5 | 72 500 | 90 500 | 6 000 | – | 5 300 |
| | 140 | 26 | 2.0 | 2.0 | – | 125.3 | 106 000 | 122 000 | 5 600 | – | 3 600 |
| | 140 | 26 | 2.0 | 2.0 | 95.3 | – | 160 000 | 167 000 | 5 000 | 8 000 | 4 500 |
| | 140 | 26 | 2.0 | 2.0 | 95.3 | – | 139 000 | 167 000 | 5 000 | 8 000 | 4 500 |
| | 140 | 33 | 2.0 | 2.0 | 95.3 | – | 214 000 | 243 000 | 5 000 | 7 100 | 4 000 |
| | 140 | 33 | 2.0 | 2.0 | 95.3 | – | 186 000 | 243 000 | 5 000 | 7 100 | 4 000 |
| | 170 | 39 | 2.1 | 2.1 | – | 147 | 190 000 | 207 000 | 4 800 | – | 2 800 |
| | 170 | 39 | 2.1 | 2.1 | 101.0 | – | 289 000 | 282 000 | 4 300 | 7 100 | 3 600 |
| | 170 | 39 | 2.1 | 2.1 | 101.0 | – | 256 000 | 282 000 | 4 300 | 7 100 | 3 600 |
| | 170 | 58 | 2.1 | 2.1 | 101.0 | – | 400 000 | 430 000 | 4 500 | 6 300 | 3 200 |
| | 170 | 58 | 2.1 | 2.1 | 101.0 | – | 355 000 | 430 000 | 4 500 | 6 300 | 3 200 |
| | 200 | 48 | 3.0 | 3.0 | 110.0 | 170 | 299 000 | 315 000 | 4 000 | – | 2 600 |
| **85** | 130 | 22 | 1.1 | 1.0 | 96.5 | 118.5 | 74 500 | 95 500 | 5 600 | – | 5 000 |
| | 150 | 28 | 2.0 | 2.0 | – | 133.8 | 120 000 | 140 000 | 5 300 | – | 3 400 |
| | 150 | 28 | 2.0 | 2.0 | 100.5 | – | 192 000 | 199 000 | 4 800 | 7 500 | 4 300 |
| | 150 | 28 | 2.0 | 2.0 | 100.5 | – | 167 000 | 199 000 | 4 800 | 7 500 | 4 300 |
| | 150 | 36 | 2.0 | 2.0 | 100.5 | – | 250 000 | 279 000 | 4 800 | 6 700 | 3 800 |
| | 150 | 36 | 2.0 | 2.0 | 100.5 | – | 217 000 | 279 000 | 4 800 | 6 700 | 3 800 |
| | 180 | 41 | 3.0 | 3.0 | – | 156 | 225 000 | 247 000 | 4 500 | – | 2 600 |
| | 180 | 41 | 3.0 | 3.0 | 108.0 | – | 212 000 | 228 000 | 4 800 | – | 2 600 |
| | 180 | 41 | 3.0 | 3.0 | 108.0 | – | 360 000 | 330 000 | 4 000 | 6 700 | 3 400 |
| | 180 | 60 | 3.0 | 3.0 | 108.0 | – | 485 000 | 485 000 | 4 300 | 6 000 | 3 000 |
| | 210 | 52 | 4.0 | 4.0 | 113.0 | 177 | 335 000 | 350 000 | 4 000 | – | 3 000 |
| **90** | 140 | 24 | 1.5 | 1.1 | 103.0 | 127 | 88 000 | 114 000 | 5 300 | – | 4 500 |
| | 160 | 30 | 2.0 | 2.0 | – | 143 | 152 000 | 178 000 | 5 000 | – | 3 200 |
| | 160 | 30 | 2.0 | 2.0 | 107.0 | – | 205 000 | 217 000 | 4 800 | 7 100 | 4 000 |
| | 160 | 30 | 2.0 | 2.0 | 107.0 | – | 182 000 | 217 000 | 4 800 | 7 100 | 4 000 |
| | 160 | 40 | 2.0 | 2.0 | 107.0 | – | 274 000 | 315 000 | 4 800 | 6 300 | 3 600 |
| | 160 | 40 | 2.0 | 2.0 | 107.0 | – | 242 000 | 315 000 | 4 800 | 6 300 | 3 600 |
| | 190 | 43 | 3.0 | 3.0 | – | 165 | 240 000 | 265 000 | 4 500 | – | 2 600 |
| | 190 | 43 | 3.0 | 3.0 | 115.0 | – | 240 000 | 265 000 | 4 500 | – | 2 600 |
| | 190 | 43 | 3.0 | 3.0 | 113.5 | – | 390 000 | 355 000 | 4 000 | 6 300 | 3 200 |
| | 190 | 64 | 3.0 | 3.0 | 113.5 | – | 535 000 | 535 000 | 4 000 | 5 600 | 2 800 |
| | 225 | 54 | 4.0 | 4.0 | 123.5 | 191.5 | 375 000 | 400 000 | 3 600 | – | 2 800 |

**Notes**
(1) (M) in the column of cage symbols are usually omitted from the bearing number.
(2) When L-Shaped thrust collars (See section for L-Shaped Thrust Collars starting on pages **B174** and **B175**) are used, the bearings become the NH type.



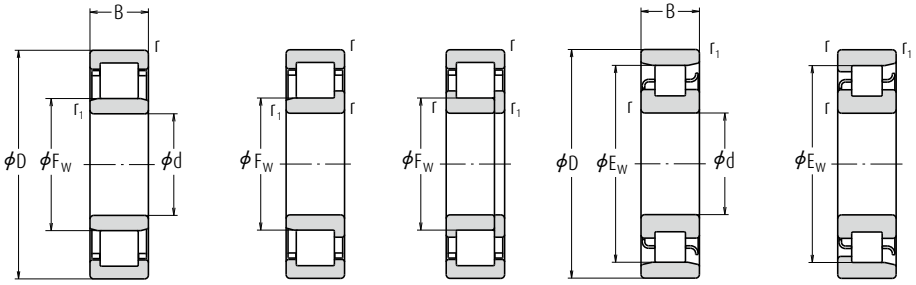




| Bearing Numbers | | | | | | | | Abutment and Fillet Dimensions (mm) | | | | | | | | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cage symbol (1) Standard option | | NU | (2) NJ | NUP | N | NF | $d_a$(3) min. | $d_b$ min. | $d_b$(4) max. | $d_c$ min. | $d_d$ min. | $D_a$(3) max. | $D_b$ max. | $D_b$ min. | $r_a$ max. | $r_b$ max. | approx. |
| **NU 1016** | **(M)** | — | **NU** | — | **NUP** | **N** | — | 86.5 | 85 | 90 | 94 | — | 118.5 | 120 | 115 | 1 | 1 | 0.969 |
| **N 216** | **W** | **M** | — | — | — | **N** | **NF** | 89 | — | — | — | — | — | 131 | 128 | 2 | 2 | 1.47 |
| **NU 216 E*** | **M** | **T, T7** | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| **NU 216 E** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | — | — | 89 | 89 | 92 | 97 | 104 | 131 | — | — | 2 | 2 | 1.7 |
| **NU 2216 E*** | **M** | **T, T7** | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| **NU 2216 E** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | — | — | 89 | 89 | 92 | 97 | 104 | 131 | — | — | 2 | 2 | 1.96 |
| **N 316** | **W** | **M** | — | — | — | **N** | **NF** | 91 | — | — | — | — | — | 159 | 150 | 2 | 2 | 3.85 |
| **NU 316 E*** | **M** | **T, T7** | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| **NU 316 E** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | — | — | 91 | 91 | 98 | 105 | 114 | 159 | — | — | 2 | 2 | 4.45 |
| **NU 2316 E*** | **M** | **T, T7** | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| **NU 2316 E** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | — | — | 91 | 91 | 98 | 105 | 114 | 159 | — | — | 2 | 2 | 5.73 |
| **NU 416** | **W** | **M** | **NU** | **NJ** | — | **N** | **NF** | 93 | 93 | 107 | 112 | 124 | 187 | 187 | 173 | 2.5 | 2.5 | 7.36 |
| **NU 1017** | **(M)** | — | **NU** | — | — | **N** | — | 91.5 | 90 | 95 | 99 | — | 123.5 | 125 | 120 | 1 | 1 | 1.01 |
| **N 217** | **W** | **M** | — | — | — | **N** | **NF** | 94 | — | — | — | — | — | 141 | 137 | 2 | 2 | 1.87 |
| **NU 217 E*** | **M** | **T,T7** | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| **NU 217 E** | **M** | **T,T7** | **NU** | **NJ** | **NUP** | — | — | 94 | 94 | 98 | 104 | 110 | 141 | — | — | 2 | 2 | 2.11 |
| **NU 2217 E*** | **M** | **T,T7** | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| **NU 2217 E** | **M** | **T,T7** | **NU** | **NJ** | **NUP** | — | — | 94 | 94 | 98 | 104 | 110 | 141 | — | — | 2 | 2 | 2.44 |
| **N 317** | **W** | **M** | — | — | — | **N** | **NF** | 98 | — | — | — | — | — | 167 | 159 | 2.5 | 2.5 | 4.53 |
| **NU 317** | **W** | **N** | **NU** | **NJ** | **NUP** | — | — | 98 | 98 | 105 | 110 | 119 | 167 | — | — | 2.5 | 2.5 | 4.6 |
| **NU 317 E*** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | — | — | 98 | 98 | 105 | 110 | 119 | 167 | — | — | 2.5 | 2.5 | 5.26 |
| **NU 2317 E*** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | — | — | 98 | 98 | 105 | 110 | 119 | 167 | — | — | 2.5 | 2.5 | 6.77 |
| **NU 417** | **M** | — | **NU** | **NJ** | — | **N** | **NF** | 101 | 101 | 110 | 115 | 128 | 194 | 194 | 180 | 3 | 3 | 9.56 |
| **NU 1018** | **(M)** | — | **NU** | — | **NUP** | **N** | — | 98 | 96.5 | 101 | 106 | — | 132 | 133.5 | 129 | 1.5 | 1 | 1.35 |
| **N 218** | **W** | **M** | — | — | — | **N** | **NF** | 99 | — | — | — | — | — | 151 | 146 | 2 | 2 | 2.31 |
| **NU 218 E*** | **M** | **T, T7** | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| **NU 218 E** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | — | — | 99 | 99 | 104 | 109 | 116 | 151 | — | — | 2 | 2 | 2.6 |
| **NU 2218 E*** | **M** | **T, T7** | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| **NU 2218 E** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | — | — | 99 | 99 | 104 | 109 | 116 | 151 | — | — | 2 | 2 | 3.11 |
| **N 318** | **W** | **M** | — | — | — | **N** | **NF** | 103 | — | — | — | — | — | 177 | 168 | 2.5 | 2.5 | 5.31 |
| **NU 318** | **W** | **M** | **NU** | **NJ** | **NUP** | — | — | 103 | 103 | 112 | 117 | 127 | 177 | — | — | 2.5 | 2.5 | 5.38 |
| **NU 318 E*** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | — | — | 103 | 103 | 111 | 117 | 127 | 177 | — | — | 2.5 | 2.5 | 6.1 |
| **NU 2318 E*** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | — | — | 103 | 103 | 111 | 117 | 127 | 177 | — | — | 2.5 | 2.5 | 7.9 |
| **NU 418** | **M** | — | **NU** | **NJ** | — | **N** | **NF** | 106 | 106 | 120 | 125 | 139 | 209 | 209 | 196 | 3 | 3 | 11.5 |

**Notes** (3) If axial loads are applied, increase $d_a$ and reduce $D_a$ from the values listed above.
(4) $d_b$ (max.) are values for adjusting rings for NU, NJ Types.
(5) The limiting speeds(mechanical) in the bearing tables are the value for the standard cage type.

**Remark** The bearings denoted by an asterisk (*) are NSKHPS Cylindrical roller bearings.

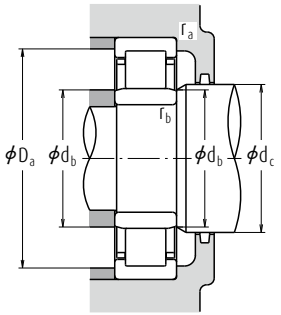
## Bore Diameter 95 – 110 mm

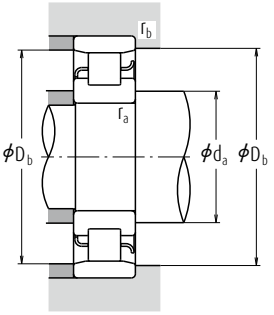


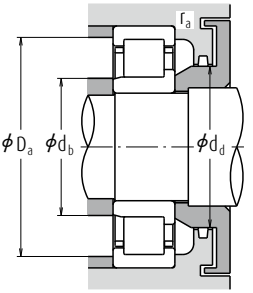

NU NJ NUP N NF

| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Speeds (min⁻¹) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Thermal Reference Speed | Limiting Speeds | |
| d | D | B | r min. | r1 min. | $F_W$ | $E_W$ | $C_r$ | $C_{0r}$ | | Mechanical (5) | Grease |
| **95** | 145 | 24 | 1.5 | 1.1 | 108.0 | 132 | 90 500 | 120 000 | 5 000 | – | 4 300 |
| | 170 | 32 | 2.1 | 2.1 | – | 151.5 | 166 000 | 196 000 | 4 800 | – | 3 000 |
| | 170 | 32 | 2.1 | 2.1 | 112.5 | – | 249 000 | 265 000 | 4 300 | 6 700 | 3 800 |
| | 170 | 32 | 2.1 | 2.1 | 112.5 | – | 220 000 | 265 000 | 4 300 | 6 700 | 3 800 |
| | 170 | 43 | 2.1 | 2.1 | 112.5 | – | 325 000 | 370 000 | 4 500 | 6 000 | 3 400 |
| | 170 | 43 | 2.1 | 2.1 | 112.5 | – | 286 000 | 370 000 | 4 500 | 6 000 | 3 400 |
| | 200 | 45 | 3.0 | 3.0 | – | 173.5 | 259 000 | 289 000 | 4 300 | – | 2 400 |
| | 200 | 45 | 3.0 | 3.0 | 121.5 | – | 259 000 | 289 000 | 4 300 | – | 2 400 |
| | 200 | 45 | 3.0 | 3.0 | 121.5 | – | 410 000 | 385 000 | 3 800 | 6 000 | 3 000 |
| | 200 | 67 | 3.0 | 3.0 | 121.5 | – | 565 000 | 585 000 | 3 800 | 5 300 | 2 600 |
| | 240 | 55 | 4.0 | 4.0 | 133.5 | 201.5 | 400 000 | 445 000 | 3 200 | – | 2 600 |
| **100** | 150 | 24 | 1.5 | 1.1 | 113 | 137 | 93 000 | 126 000 | 4 800 | – | 4 300 |
| | 180 | 34 | 2.1 | 2.1 | – | 160 | 183 000 | 217 000 | 4 500 | – | 2 800 |
| | 180 | 34 | 2.1 | 2.1 | 119 | – | 305 000 | 305 000 | 4 300 | 6 300 | 3 600 |
| | 180 | 46 | 2.1 | 2.1 | 119 | – | 410 000 | 445 000 | 4 300 | 5 600 | 3 200 |
| | 215 | 47 | 3.0 | 3.0 | – | 185.5 | 299 000 | 335 000 | 4 000 | – | 2 200 |
| | 215 | 47 | 3.0 | 3.0 | 129.5 | – | 299 000 | 335 000 | 4 000 | – | 2 200 |
| | 215 | 47 | 3.0 | 3.0 | 127.5 | – | 465 000 | 425 000 | 3 600 | 5 600 | 2 800 |
| | 215 | 73 | 3.0 | 3.0 | 127.5 | – | 700 000 | 715 000 | 3 400 | 5 600 | 2 400 |
| | 250 | 58 | 4.0 | 4.0 | 139 | 211 | 450 000 | 500 000 | 3 000 | – | 2 600 |
| **105** | 160 | 26 | 2.0 | 1.1 | 119.5 | 145.5 | 109 000 | 149 000 | 4 500 | – | 4 000 |
| | 190 | 36 | 2.1 | 2.1 | – | 168.8 | 201 000 | 241 000 | 4 500 | – | 2 600 |
| | 190 | 36 | 2.1 | 2.1 | 125 | – | 320 000 | 310 000 | 4 300 | 6 000 | 3 400 |
| | 225 | 49 | 3.0 | 3.0 | – | 195 | 340 000 | 390 000 | 3 800 | – | 2 200 |
| | 225 | 49 | 3.0 | 3.0 | 133 | – | 525 000 | 480 000 | 3 400 | 5 300 | 2 600 |
| | 260 | 60 | 4.0 | 4.0 | 144.5 | 220.5 | 495 000 | 555 000 | 2 800 | – | 2 400 |
| **110** | 170 | 28 | 2.0 | 1.1 | 125 | 155 | 131 000 | 174 000 | 4 500 | – | 3 800 |
| | 200 | 38 | 2.1 | 2.1 | – | 178.5 | 229 000 | 272 000 | 4 300 | – | 2 600 |
| | 200 | 38 | 2.1 | 2.1 | 132.5 | – | 360 000 | 365 000 | 4 000 | 5 600 | 3 200 |
| | 200 | 53 | 2.1 | 2.1 | 132.5 | – | 470 000 | 515 000 | 4 000 | 5 000 | 2 800 |
| | 240 | 50 | 3.0 | 3.0 | – | 207 | 380 000 | 435 000 | 3 400 | – | 2 000 |
| | 240 | 50 | 3.0 | 3.0 | 143 | – | 555 000 | 525 000 | 3 200 | 5 000 | 2 600 |
| | 240 | 80 | 3.0 | 3.0 | 143 | – | 830 000 | 880 000 | 3 000 | 4 500 | 2 200 |
| | 280 | 65 | 4.0 | 4.0 | 155 | – | 550 000 | 620 000 | 2 600 | – | 2 200 |

**Notes** (1) (M) in the column of cage symbols are usually omitted from the bearing number.
(2) When L-Shaped thrust collars (See section for L-Shaped Thrust Collars starting on page **B175**) are used, the bearings become the NH type.



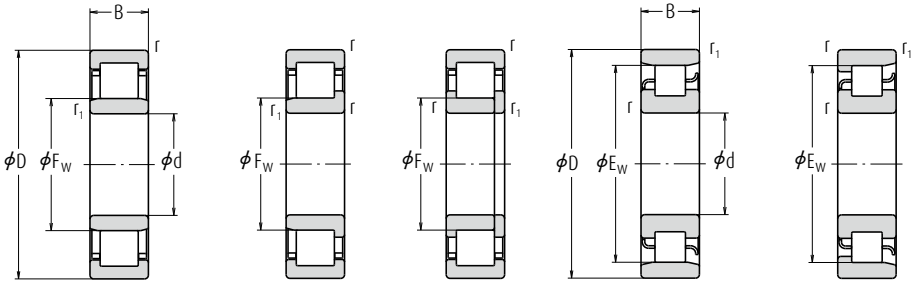




| Bearing Numbers | | | | | | | | Abutment and Fillet Dimensions (mm) | | | | | | | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cage symbol (1) Standard option | | NU | (2) NJ | NUP | N | NF | $d_a$(3) min. | $d_b$ min. | $d_b$(4) max. | $d_c$ min. | $d_d$ min. | $D_a$(3) max. | $D_b$ max. | $D_b$ min. | $r_a$ max. | $r_b$ max. | approx. |
| **NU 1019** | **(M)** | **—** | **NU** | **NJ** | **—** | **N** | **—** | 103 | 101.5 | 106 | 111 | — | 137 | 138.5 | 134 | 1.5 | 1 | 1.41 |
| **N 219** | **W** | **M** | **—** | **—** | **—** | **N** | **NF** | 106 | — | — | — | — | — | 159 | 155 | 2 | 2 | 2.79 |
| **NU 219 E*** | **M** | **T, T7** | **—** | **—** | **—** | **—** | **—** | — | — | — | — | — | — | — | — | — | — | — |
| **NU 219 E** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | **—** | **—** | 106 | 106 | 110 | 116 | 123 | 159 | — | — | 2 | 2 | 3.17 |
| **NU 2219 E*** | **M** | **T, T7** | **—** | **—** | **—** | **—** | **—** | — | — | — | — | — | — | — | — | — | — | — |
| **NU 2219 E** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | **—** | **—** | 106 | 106 | 110 | 116 | 123 | 159 | — | — | 2 | 2 | 3.81 |
| **N 319** | **W** | **M** | **—** | **—** | **—** | **N** | **NF** | 108 | — | — | — | — | — | 187 | 177 | 2.5 | 2.5 | 6.09 |
| **NU 319** | **W** | **M** | **NU** | **NJ** | **NUP** | **—** | **—** | 108 | 108 | 118 | 124 | 134 | 187 | — | — | 2.5 | 2.5 | 6.23 |
| **NU 319 E*** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | **—** | **—** | 108 | 108 | 118 | 124 | 134 | 187 | — | — | 2.5 | 2.5 | 7.13 |
| **NU 2319 E*** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | **—** | **—** | 108 | 108 | 118 | 124 | 134 | 187 | — | — | 2.5 | 2.5 | 9.21 |
| **NU 419** | **M** | **—** | **NU** | **NJ** | **NUP** | **—** | **NF** | 111 | 111 | 130 | 136 | 149 | 224 | 224 | 206 | 3 | 3 | 13.6 |
| **NU 1020** | **(M)** | **—** | **NU** | **NJ** | **NUP** | **N** | **—** | 108 | 106.5 | 111 | 116 | — | 142 | 143.5 | 139 | 1.5 | 1 | 1.47 |
| **N 220** | **W** | **M** | **—** | **—** | **—** | **N** | **NF** | 111 | — | — | — | — | — | 169 | 163 | 2 | 2 | 3.36 |
| **NU 220 E*** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | **—** | **—** | 111 | 111 | 116 | 122 | 130 | 169 | — | — | 2 | 2 | 3.81 |
| **NU 2220 E*** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | **—** | **—** | 111 | 111 | 116 | 122 | 130 | 169 | — | — | 2 | 2 | 4.69 |
| **N 320** | **W** | **M** | **—** | **—** | **—** | **N** | **NF** | 113 | — | — | — | — | — | 202 | 190 | 2.5 | 2.5 | 7.59 |
| **NU 320** | **W** | **M** | **NU** | **NJ** | **NUP** | **—** | **—** | 113 | 113 | 126 | 132 | 143 | 202 | — | — | 2.5 | 2.5 | 7.69 |
| **NU 320 E*** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | **—** | **—** | 113 | 113 | 124 | 132 | 143 | 202 | — | — | 2.5 | 2.5 | 8.63 |
| **NU 2320 E*** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | **—** | **—** | 113 | 113 | 124 | 132 | 143 | 202 | — | — | 2.5 | 2.5 | 11.8 |
| **NU 420** | **M** | **—** | **NU** | **NJ** | **—** | **N** | **NF** | 116 | 116 | 135 | 141 | 156 | 234 | 234 | 215 | 3 | 3 | 15.5 |
| **NU 1021** | **(M)** | **—** | **NU** | **—** | **—** | **N** | **NF** | 114 | 111.5 | 118 | 122 | — | 151 | 153.5 | 147 | 2 | 1 | 1.83 |
| **N 221** | **W** | **M** | **—** | **—** | **—** | **N** | **NF** | 116 | — | — | — | — | — | 179 | 172 | 2 | 2 | 4.0 |
| **NU 221 E*** | **M** | **—** | **NU** | **NJ** | **NUP** | **—** | **—** | 116 | 116 | 121 | 129 | 137 | 179 | — | — | 2 | 2 | 4.58 |
| **N 321** | **W** | **M** | **—** | **—** | **—** | **N** | **NF** | 118 | — | — | — | — | — | 212 | 199 | 2.5 | 2.5 | 8.69 |
| **NU 321 E*** | **M** | **—** | **NU** | **NJ** | **NUP** | **—** | **—** | 118 | 118 | 131 | 137 | 149 | 212 | — | — | 2.5 | 2.5 | 9.84 |
| **NU 421** | **M** | **—** | **NU** | **NJ** | **—** | **N** | **NF** | 121 | 121 | 141 | 147 | 162 | 244 | 244 | 225 | 3 | 3 | 17.3 |
| **NU 1022** | **(M)** | **—** | **NU** | **NJ** | **—** | **N** | **NF** | 119 | 116.5 | 123 | 128 | — | 161 | 163.5 | 157 | 2 | 1 | 2.27 |
| **N 222** | **W** | **M** | **—** | **—** | **—** | **N** | **NF** | 121 | — | — | — | — | — | 189 | 182 | 2 | 2 | 4.64 |
| **NU 222 E*** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | **—** | **—** | 121 | 121 | 129 | 135 | 144 | 189 | — | — | 2 | 2 | 5.37 |
| **NU 2222 E*** | **M** | **—** | **NU** | **NJ** | **NUP** | **—** | **—** | 121 | 121 | 129 | 135 | 144 | 189 | — | — | 2 | 2 | 7.65 |
| **N 322** | **W** | **M** | **—** | **—** | **—** | **N** | **NF** | 123 | — | — | — | — | — | 227 | 211 | 2.5 | 2.5 | 10.3 |
| **NU 322 E*** | **M** | **—** | **NU** | **NJ** | **NUP** | **—** | **—** | 123 | 123 | 139 | 145 | 158 | 227 | — | — | 2.5 | 2.5 | 11.8 |
| **NU 2322 E*** | **M** | **T,T7** | **NU** | **NJ** | **—** | **—** | **—** | 123 | 123 | 139 | 145 | 158 | 227 | — | — | 2.5 | 2.5 | 18.8 |
| **NU 422** | **M** | **—** | **NU** | **NJ** | **—** | **—** | **—** | 126 | 126 | 151 | 157 | 173 | 264 | — | — | 3 | 3 | 22.1 |

**Notes** (3) If axial loads are applied, increase $d_a$ and reduce $D_a$ from the values listed above.
(4) $d_b$ (max.) are values for adjusting rings for NU, NJ Types.
(5) The limiting speeds (mechanical) in the bearing tables are the value for the standard cage type.

**Remark** The bearings denoted by an asterisk (*) are NSKHPS Cylindrical roller bearings.

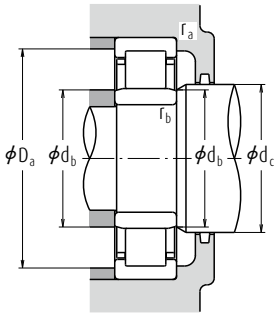
## Bore Diameter 120 – 150 mm

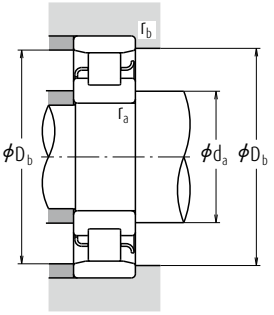


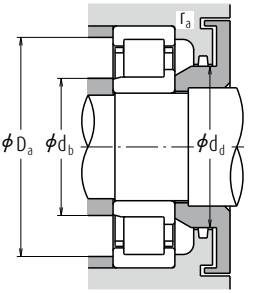

NU NJ NUP N NF

| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Speeds (min⁻¹) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Thermal Reference Speed | Limiting Speeds | |
| d | D | B | r min. | r1 min. | Fw | Ew | Cr | C0r | | Mechanical (5) | Grease |
| **120** | 180 | 28 | 2.0 | 1.1 | 135 | 165 | 139 000 | 191 000 | 4 000 | – | 3 400 |
| | 215 | 40 | 2.1 | 2.1 | – | 191.5 | 260 000 | 320 000 | 4 000 | – | 2 400 |
| | 215 | 40 | 2.1 | 2.1 | 143.5 | – | 410 000 | 420 000 | 3 600 | 5 300 | 3 000 |
| | 215 | 58 | 2.1 | 2.1 | 143.5 | – | 555 000 | 620 000 | 3 600 | 4 800 | 2 600 |
| | 260 | 55 | 3.0 | 3.0 | – | 226 | 450 000 | 510 000 | 3 000 | – | 1 800 |
| | 260 | 55 | 3.0 | 3.0 | 154 | – | 650 000 | 610 000 | 2 800 | 4 800 | 2 200 |
| | 260 | 86 | 3.0 | 3.0 | 154 | – | 975 000 | 1 030 000 | 2 600 | 4 300 | 2 000 |
| | 310 | 72 | 5.0 | 5.0 | 170 | 260 | 675 000 | 770 000 | 2 400 | – | 2 000 |
| **130** | 200 | 33 | 2.0 | 1.1 | 148 | 182 | 172 000 | 238 000 | 4 000 | – | 3 200 |
| | 230 | 40 | 3.0 | 3.0 | – | 204 | 270 000 | 340 000 | 3 800 | – | 2 200 |
| | 230 | 40 | 3.0 | 3.0 | 153.5 | – | 445 000 | 455 000 | 3 400 | 5 000 | 2 600 |
| | 230 | 64 | 3.0 | 3.0 | 153.5 | – | 650 000 | 735 000 | 3 400 | 4 500 | 2 400 |
| | 280 | 58 | 4.0 | 4.0 | – | 243 | 500 000 | 570 000 | 2 800 | – | 2 200 |
| | 280 | 58 | 4.0 | 4.0 | 167 | – | 760 000 | 735 000 | 2 600 | 4 300 | 2 200 |
| | 280 | 93 | 4.0 | 4.0 | 167 | – | 1 130 000 | 1 230 000 | 2 400 | 3 800 | 1 900 |
| | 340 | 78 | 5.0 | 5.0 | 185 | 285 | 825 000 | 955 000 | 2 000 | – | 1 800 |
| **140** | 210 | 33 | 2.0 | 1.1 | 158 | 192 | 176 000 | 250 000 | 3 800 | – | 3 000 |
| | 250 | 42 | 3.0 | 3.0 | – | 221 | 297 000 | 375 000 | 3 400 | – | 2 000 |
| | 250 | 42 | 3.0 | 3.0 | 169 | – | 485 000 | 515 000 | 3 200 | 4 500 | 2 400 |
| | 250 | 68 | 3.0 | 3.0 | 169 | – | 675 000 | 790 000 | 3 200 | 4 000 | 2 200 |
| | 300 | 62 | 4.0 | 4.0 | – | 260 | 550 000 | 640 000 | 2 600 | – | 2 000 |
| | 300 | 62 | 4.0 | 4.0 | 180 | – | 815 000 | 795 000 | 2 400 | 4 000 | 2 000 |
| | 300 | 102 | 4.0 | 4.0 | 180 | – | 1 250 000 | 1 380 000 | 2 200 | 2 600 | 1 700 |
| | 360 | 82 | 5.0 | 5.0 | 198 | 302 | 875 000 | 1 020 000 | 1 900 | – | 1 700 |
| **150** | 225 | 35 | 2.1 | 1.5 | 169.5 | 205.5 | 202 000 | 294 000 | 3 600 | – | 2 800 |
| | 270 | 45 | 3.0 | 3.0 | – | 238 | 360 000 | 465 000 | 3 000 | – | 1 800 |
| | 270 | 45 | 3.0 | 3.0 | 182 | – | 550 000 | 595 000 | 2 800 | 4 300 | 2 200 |
| | 270 | 73 | 3.0 | 3.0 | 182 | – | 780 000 | 930 000 | 2 800 | 3 800 | 2 000 |
| | 320 | 65 | 4.0 | 4.0 | – | 277 | 665 000 | 805 000 | 2 200 | – | 1 800 |
| | 320 | 65 | 4.0 | 4.0 | 193 | – | 930 000 | 920 000 | 2 200 | 3 800 | 1 800 |
| | 320 | 108 | 4.0 | 4.0 | 193 | – | 1 430 000 | 1 600 000 | 2 000 | 2 400 | 1 600 |
| | 380 | 85 | 5.0 | 5.0 | 213 | – | 930 000 | 1 120 000 | 1 700 | – | 1 600 |

**Notes** (1) (M) in the column of cage symbols are usually omitted from the bearing number.
(2) When L-Shaped thrust collars (See section for L-Shaped Thrust Collars starting on page **B175**) are used, the bearings become the NH type.



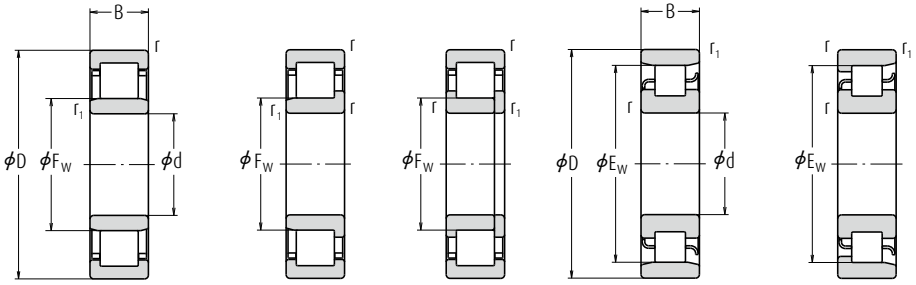




| Bearing Numbers | | | | | | | | Abutment and Fillet Dimensions (mm) | | | | | | | | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cage symbol (1) Standard option | | NU | (2) NJ | NUP | N | NF | $d_a$(3) min. | $d_b$ min. | $d_b$(4) max. | $d_c$ min. | $d_d$ min. | $D_a$(3) max. | $D_b$ max. | $D_b$ min. | $r_a$ max. | $r_b$ max. | approx. |
| **NU 1024** | **(M)** | **—** | **NU** | **NJ** | **NUP** | **N** | **—** | 129 | 126.5 | 133 | 138 | — | 171 | 173.5 | 167 | 2 | 1 | 2.43 |
| **N 224** | **W** | **M** | **—** | **—** | **—** | **N** | **NF** | 131 | — | — | — | — | — | 204 | 196 | 2 | 2 | 5.63 |
| **NU 224 E*** | **M** | **—** | **NU** | **NJ** | **NUP** | **—** | **—** | 131 | 131 | 140 | 146 | 156 | 204 | — | — | 2 | 2 | 6.43 |
| **NU 2224 E*** | **M** | **—** | **NU** | **NJ** | **NUP** | **—** | **—** | 131 | 131 | 140 | 146 | 156 | 204 | — | — | 2 | 2 | 9.51 |
| **N 324** | **W** | **M** | **—** | **—** | **—** | **N** | **NF** | 133 | — | — | — | — | — | 247 | 230 | 2.5 | 2.5 | 12.9 |
| **NU 324 E*** | **M** | **—** | **NU** | **NJ** | **NUP** | **—** | **—** | 133 | 133 | 150 | 156 | 171 | 247 | — | — | 2.5 | 2.5 | 15 |
| **NU 2324 E*** | **M** | **—** | **NU** | **NJ** | **NUP** | **—** | **—** | 133 | 133 | 150 | 156 | 171 | 247 | — | — | 2.5 | 2.5 | 25 |
| **NU 424** | **M** | **—** | **NU** | **NJ** | **NUP** | **N** | **—** | 140 | 140 | 166 | 172 | 190 | 290 | 290 | 266 | 4 | 4 | 30.2 |
| **NU 1026** | **(M)** | **—** | **NU** | **NJ** | **—** | **N** | **NF** | 139 | 136.5 | 146 | 151 | — | 191 | 193.5 | 184 | 2 | 1 | 3.66 |
| **N 226** | **W** | **M** | **—** | **—** | **—** | **N** | **NF** | 143 | — | — | — | — | — | 217 | 208 | 2.5 | 2.5 | 6.48 |
| **NU 226 E*** | **M** | **T, T7** | **NU** | **NJ** | **NUP** | **—** | **—** | 143 | 143 | 150 | 158 | 168 | 217 | — | — | 2.5 | 2.5 | 8.03 |
| **NU 2226 E*** | **M** | **—** | **NU** | **NJ** | **NUP** | **—** | **—** | 143 | 143 | 150 | 158 | 168 | 217 | — | — | 2.5 | 2.5 | 9.44 |
| **N 326** | **M** | **—** | **—** | **—** | **—** | **N** | **NF** | 146 | — | — | — | — | — | 264 | 247.5 | 3 | 3 | 17.7 |
| **NU 326 E*** | **M** | **—** | **NU** | **NJ** | **NUP** | **—** | **—** | 146 | 146 | 163 | 169 | 184 | 264 | — | — | 3 | 3 | 18.7 |
| **NU 2326 E*** | **M** | **—** | **NU** | **NJ** | **NUP** | **—** | **—** | 146 | 146 | 163 | 169 | 184 | 264 | — | — | 3 | 3 | 30 |
| **NU 426** | **M** | **—** | **NU** | **NJ** | **—** | **—** | **NF** | 150 | 150 | 180 | 187 | 208 | 320 | 320 | 291 | 4 | 4 | 39.6 |
| **NU 1028** | **(M)** | **—** | **NU** | **NJ** | **NUP** | **N** | **—** | 149 | 146.5 | 156 | 161 | — | 201 | 203.5 | 194 | 2 | 1 | 3.87 |
| **N 228** | **W** | **M** | **—** | **—** | **—** | **N** | **NF** | 153 | — | — | — | — | — | 237 | 225 | 2.5 | 2.5 | 8.08 |
| **NU 228 E*** | **M** | **—** | **NU** | **NJ** | **NUP** | **—** | **—** | 153 | 153 | 165 | 171 | 182 | 237 | — | — | 2.5 | 2.5 | 9.38 |
| **NU 2228 E*** | **M** | **—** | **NU** | **NJ** | **NUP** | **—** | **—** | 153 | 153 | 165 | 171 | 182 | 237 | — | — | 2.5 | 2.5 | 15.2 |
| **N 328** | **M** | **—** | **—** | **—** | **—** | **N** | **NF** | 156 | — | — | — | — | — | 284 | 266 | 3 | 3 | 21.7 |
| **NU 328 E*** | **M** | **—** | **NU** | **NJ** | **NUP** | **—** | **—** | 156 | 156 | 176 | 182 | 198 | 284 | — | — | 3 | 3 | 22.8 |
| **NU 2328 E*** | **M** | **—** | **NU** | **NJ** | **NUP** | **—** | **—** | 156 | 156 | 176 | 182 | 198 | 284 | — | — | 3 | 3 | 37.7 |
| **NU 428** | **M** | **—** | **NU** | **NJ** | **—** | **N** | **—** | 160 | 160 | 193 | 200 | 222 | 340 | 340 | 308 | 4 | 4 | 46.4 |
| **NU 1030** | **(M)** | **—** | **NU** | **NJ** | **—** | **N** | **NF** | 161 | 158 | 167 | 173 | — | 214 | 217 | 208 | 2 | 1.5 | 4.77 |
| **N 230** | **W** | **M** | **—** | **—** | **—** | **N** | **NF** | 163 | — | — | — | — | — | 257 | 242 | 2.5 | 2.5 | 10.4 |
| **NU 230 E*** | **M** | **—** | **NU** | **NJ** | **NUP** | **—** | **—** | 163 | 163 | 177 | 184 | 196 | 257 | — | — | 2.5 | 2.5 | 11.9 |
| **NU 2230 E*** | **M** | **—** | **NU** | **NJ** | **NUP** | **—** | **—** | 163 | 163 | 177 | 184 | 196 | 257 | — | — | 2.5 | 2.5 | 19.3 |
| **N 330** | **M** | **—** | **—** | **—** | **—** | **N** | **NF** | 166 | — | — | — | — | — | 304 | 283 | 3 | 3 | 25.8 |
| **NU 330 E*** | **M** | **—** | **NU** | **NJ** | **NUP** | **—** | **—** | 166 | 166 | 188 | 195 | 213 | 304 | — | — | 3 | 3 | 27.1 |
| **NU 2330 E*** | **M** | **—** | **NU** | **NJ** | **NUP** | **—** | **—** | 166 | 166 | 188 | 195 | 213 | 304 | — | — | 3 | 3 | 45.1 |
| **NU 430** | **M** | **—** | **NU** | **NJ** | **—** | **—** | **—** | 170 | 170 | 208 | 216 | 237 | 360 | — | — | 4 | 4 | 55.8 |

**Notes** (3) If axial loads are applied, increase $d_a$ and reduce $D_a$ from the values listed above.
(4) $d_b$ (max.) are values for adjusting rings for NU, NJ Types.
(5) The limiting speeds (mechanical) in the bearing tables are the value for the standard cage type.

**Remark** The bearings denoted by an asterisk (*) are NSKHPS Cylindrical roller bearings.

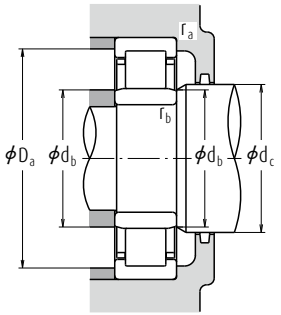
## Bore Diameter 160 - 190 mm

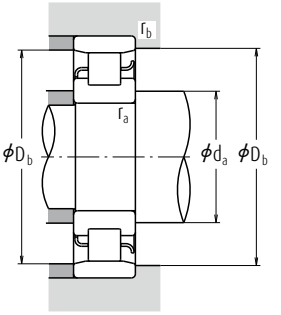


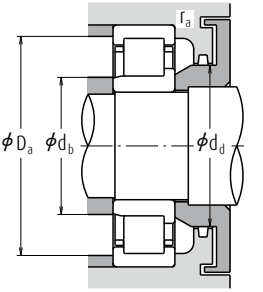

NU NJ NUP N NF

| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Speeds (min⁻¹) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Thermal Reference Speed | Limiting Speeds | |
| d | D | B | r min. | r1 min. | $F_W$ | $E_W$ | $C_r$ | $C_{0r}$ | | Mechanical (5) | Grease |
| **160** | 240 | 38 | 2.1 | 1.5 | 180 | 220 | 238 000 | 340 000 | 3 400 | – | 2 600 |
| | 290 | 48 | 3.0 | 3.0 | – | 255 | 430 000 | 570 000 | 2 800 | – | 2 200 |
| | 290 | 48 | 3.0 | 3.0 | 195 | – | 615 000 | 665 000 | 2 600 | 4 000 | 2 200 |
| | 290 | 80 | 3.0 | 3.0 | 193 | – | 995 000 | 1 190 000 | 2 400 | 3 600 | 1 900 |
| | 340 | 68 | 4.0 | 4.0 | – | 292 | 700 000 | 875 000 | 2 000 | – | 1 700 |
| | 340 | 68 | 4.0 | 4.0 | 204 | – | 1 060 000 | 1 050 000 | 1 900 | 3 600 | 1 700 |
| | 340 | 114 | 4.0 | 4.0 | 204 | – | 1 310 000 | 1 820 000 | 1 800 | 2 400 | 1 500 |
| **170** | 260 | 42 | 2.1 | 2.1 | 193 | 237 | 287 000 | 415 000 | 3 200 | – | 2 400 |
| | 310 | 52 | 4 | 4 | – | 272 | 475 000 | 635 000 | 2 600 | – | 2 000 |
| | 310 | 52 | 4 | 4 | 207 | – | 740 000 | 800 000 | 2 400 | 3 800 | 2 000 |
| | 310 | 86 | 4 | 4 | 205 | – | 1 140 000 | 1 330 000 | 2 200 | 3 200 | 1 800 |
| | 360 | 72 | 4 | 4 | – | 310 | 795 000 | 1 010 000 | 1 900 | – | 1 600 |
| | 360 | 72 | 4 | 4 | 218 | – | 930 000 | 1 150 000 | 1 800 | 3 400 | 1 600 |
| | 360 | 120 | 4 | 4 | 216 | – | 1 490 000 | 2 070 000 | 1 600 | 2 200 | 1 400 |
| **180** | 280 | 46 | 2.1 | 2.1 | 205 | 255 | 355 000 | 510 000 | 3 000 | – | 2 200 |
| | 320 | 52 | 4 | 4 | – | 282 | 495 000 | 675 000 | 2 400 | – | 1 900 |
| | 320 | 52 | 4 | 4 | 217 | – | 770 000 | 850 000 | 2 200 | 3 600 | 1 900 |
| | 320 | 86 | 4 | 4 | 215 | – | 1 240 000 | 1 510 000 | 2 000 | 3 200 | 1 700 |
| | 380 | 75 | 4 | 4 | – | 328 | 905 000 | 1 150 000 | 1 700 | – | 1 500 |
| | 380 | 75 | 4 | 4 | 231 | – | 985 000 | 1 230 000 | 1 700 | 2 800 | 1 500 |
| | 380 | 126 | 4 | 4 | 227 | – | 1 560 000 | 2 220 000 | 1 500 | 2 000 | 1 300 |
| **190** | 290 | 46 | 2.1 | 2.1 | 215 | 265 | 365 000 | 535 000 | 2 800 | – | 2 000 |
| | 340 | 55 | 4 | 4 | – | 299 | 555 000 | 770 000 | 2 200 | – | 1 800 |
| | 340 | 55 | 4 | 4 | 230 | – | 885 000 | 955 000 | 2 000 | 3 400 | 1 800 |
| | 340 | 92 | 4 | 4 | 228 | – | 1 360 000 | 1 670 000 | 1 900 | 3 000 | 1 600 |
| | 400 | 78 | 5 | 5 | – | 345 | 975 000 | 1 260 000 | 1 600 | – | 1 400 |
| | 400 | 78 | 5 | 5 | 245 | – | 1 060 000 | 1 340 000 | 1 600 | 2 600 | 1 400 |
| | 400 | 132 | 5 | 5 | 240 | – | 1 770 000 | 2 520 000 | 1 400 | 2 000 | 1 300 |

**Notes** (1) (M) in the column of cage symbols are usually omitted from the bearing number.
(2) When L-Shaped thrust collars (See section for L-Shaped Thrust Collars starting on page **B175**) are used, the bearings become the NH type.



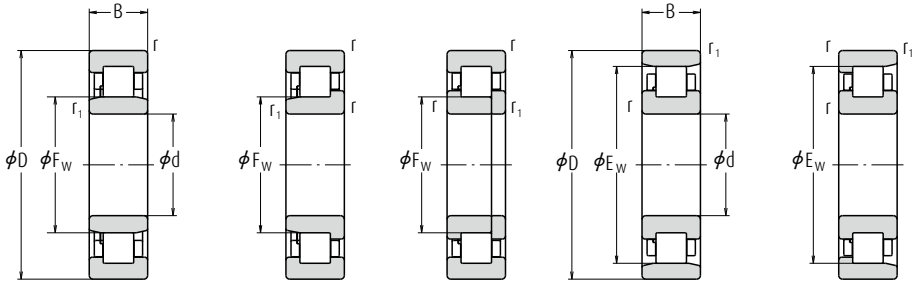




| Bearing Numbers | | | | | | | | Abutment and Fillet Dimensions (mm) | | | | | | | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cage symbol (1) Standard option | | NU | (2) NJ | NUP | N | NF | $d_a$(3) min. | $d_b$ min. | $d_b$(4) max. | $d_c$ min. | $d_d$ min. | $D_a$(3) max. | $D_b$ max. | $D_b$ min. | $r_a$ max. | $r_b$ max. | approx. |
| **NU 1032** | **(M)** | — | **NU** | **NJ** | — | **N** | **NF** | 171 | 168 | 178 | 184 | — | 229 | 232 | 222 | 2 | 1.5 | 5.81 |
| **N 232** | **M** | — | — | — | — | **N** | **NF** | 173 | — | — | — | — | — | 277 | 261 | 2.5 | 2.5 | 14.1 |
| **NU 232 E*** | **M** | — | **NU** | **NJ** | **NUP** | — | — | 173 | 173 | 190 | 197 | 210 | 277 | — | — | 2.5 | 2.5 | 14.7 |
| **NU 2232 E*** | **M** | — | **NU** | **NJ** | **NUP** | — | — | 173 | 173 | 188 | 197 | 210 | 277 | — | — | 2.5 | 2.5 | 24.5 |
| **N 332** | **M** | — | — | — | — | **N** | — | 176 | — | — | — | — | — | 324 | 298 | 3 | 3 | 30.8 |
| **NU 332 E*** | **M** | — | **NU** | **NJ** | **NUP** | — | — | 176 | 176 | 199 | 211 | 228 | 324 | — | — | 3 | 3 | 32.1 |
| **NU 2332 E** | **M** | — | **NU** | **NJ** | **NUP** | — | — | 176 | 176 | 199 | 211 | 228 | 324 | — | — | 3 | 3 | 53.9 |
| **NU 1034** | **(M)** | — | **NU** | **NJ** | — | **N** | — | 181 | 181 | 190 | 197 | — | 249 | 249 | 239 | 2 | 2 | 7.91 |
| **N 234** | **M** | — | — | — | — | **N** | **NF** | 186 | — | — | — | — | — | 294 | 278 | 3 | 3 | 17.4 |
| **NU 234 E*** | **M** | — | **NU** | **NJ** | **NUP** | — | — | 186 | 186 | 202 | 211 | 223 | 294 | — | — | 3 | 3 | 18.3 |
| **NU 2234 E*** | **M** | — | **NU** | **NJ** | **NUP** | — | — | 186 | 186 | 200 | 211 | 223 | 294 | — | — | 3 | 3 | 29.9 |
| **N 334** | **M** | — | — | — | — | **N** | **NF** | 186 | — | — | — | — | — | 344 | 316 | 3 | 3 | 36.6 |
| **NU 334 E** | **M** | — | **NU** | **NJ** | **NUP** | — | — | 186 | 186 | 213 | 223 | 241 | 344 | — | — | 3 | 3 | 37.9 |
| **NU 2334 E** | **M** | — | **NU** | **NJ** | **NUP** | — | — | 186 | 186 | 210 | 223 | 241 | 344 | — | — | 3 | 3 | 63.4 |
| **NU 1036** | **(M)** | — | **NU** | **NJ** | — | **N** | **NF** | 191 | 191 | 202 | 209 | — | 269 | 269 | 258 | 2 | 2 | 10.2 |
| **N 236** | **M** | — | — | — | — | **N** | **NF** | 196 | — | — | — | — | — | 304 | 288 | 3 | 3 | 18.1 |
| **NU 236 E*** | **M** | — | **NU** | **NJ** | **NUP** | — | — | 196 | 196 | 212 | 221 | 233 | 304 | — | — | 3 | 3 | 19 |
| **NU 2236 E*** | **M** | — | **NU** | **NJ** | **NUP** | — | — | 196 | 196 | 210 | 221 | 233 | 304 | — | — | 3 | 3 | 31.4 |
| **N 336** | **M** | — | — | — | — | **N** | **NF** | 196 | — | — | — | — | — | 364 | 335 | 3 | 3 | 42.6 |
| **NU 336 E** | **M** | — | **NU** | **NJ** | **NUP** | — | — | 196 | 196 | 226 | 235 | 255 | 364 | — | — | 3 | 3 | 44 |
| **NU 2336 E** | **M** | — | **NU** | **NJ** | **NUP** | — | — | 196 | 196 | 222 | 235 | 255 | 364 | — | — | 3 | 3 | 74.6 |
| **NU 1038** | **(M)** | — | **NU** | **NJ** | — | **N** | — | 201 | 201 | 212 | 219 | — | 279 | 279 | 268 | 2 | 2 | 10.7 |
| **N 238** | **M** | — | — | — | — | **N** | **NF** | 206 | — | — | — | — | — | 324 | 305 | 3 | 3 | 22 |
| **NU 238 E*** | **M** | — | **NU** | **NJ** | **NUP** | — | — | 206 | 206 | 225 | 234 | 247 | 324 | — | — | 3 | 3 | 23 |
| **NU 2238 E*** | **M** | — | **NU** | **NJ** | **NUP** | — | — | 206 | 206 | 223 | 234 | 247 | 324 | — | — | 3 | 3 | 38.3 |
| **N 338** | **M** | — | — | — | — | **N** | — | 210 | — | — | — | — | — | 380 | 352 | 4 | 4 | 48.7 |
| **NU 338 E** | **M** | — | **NU** | **NJ** | **NUP** | — | — | 210 | 210 | 240 | 248 | 268 | 380 | — | — | 4 | 4 | 50.6 |
| **NU 2338 E** | **M** | — | **NU** | **NJ** | **NUP** | — | — | 210 | 210 | 235 | 248 | 268 | 380 | — | — | 4 | 4 | 86.2 |

**Notes** (3) If axial loads are applied, increase $d_a$ and reduce $D_a$ from the values listed above.
(4) $d_b$ (max.) are values for adjusting rings for NU, NJ Types.
(5) The limiting speeds (mechanical) in the bearing tables are the value for the standard cage type.

**Remark** The bearings denoted by an asterisk (*) are NSKHPS Cylindrical roller bearings.

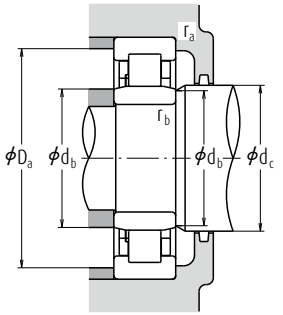
## Bore Diameter 200 – 320 mm

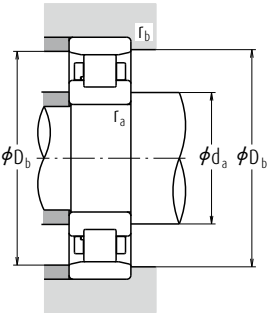


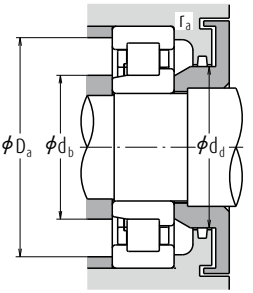

NU NJ NUP N NF

| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Speeds (min-1) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Limiting Speeds | |
| d | D | B | r min. | r1 min. | Fw | Ew | Cr | C0r | Thermal Reference Speed | Mechanical (5) | Grease |
| **200** | 310 | 51 | 2.1 | 2.1 | 229 | 281 | 390 000 | 580 000 | 2 600 | — | 2 000 |
| | 360 | 58 | 4 | 4 | — | 316 | 620 000 | 865 000 | 2 000 | — | 1 700 |
| | 360 | 58 | 4 | 4 | 243 | — | 945 000 | 1 060 000 | 1 900 | 3 200 | 1 700 |
| | 360 | 98 | 4 | 4 | 241 | — | 1 500 000 | 1 870 000 | 1 800 | 2 200 | 1 500 |
| | 420 | 80 | 5 | 5 | — | 360 | 975 000 | 1 270 000 | 1 600 | — | 1 300 |
| | 420 | 80 | 5 | 5 | 258 | — | 1 140 000 | 1 450 000 | 1 500 | 2 600 | 1 200 |
| | 420 | 138 | 5 | 5 | 253 | — | 1 910 000 | 2 760 000 | 1 300 | 1 900 | 1 200 |
| **220** | 340 | 56 | 3 | 3 | 250 | 310 | 500 000 | 750 000 | 2 400 | — | 1 800 |
| | 400 | 65 | 4 | 4 | — | 350 | 760 000 | 1 080 000 | 1 800 | — | 1 500 |
| | 400 | 65 | 4 | 4 | 270 | — | 1 110 000 | 1 250 000 | 1 800 | — | 1 500 |
| | 400 | 108 | 4 | 4 | 270 | — | 1 140 000 | 1 810 000 | 1 700 | — | 1 300 |
| | 460 | 88 | 5 | 5 | — | 396 | 1 190 000 | 1 570 000 | 1 400 | — | 1 200 |
| | 460 | 88 | 5 | 5 | 284 | — | 1 190 000 | 1 570 000 | 1 400 | — | 1 200 |
| **240** | 360 | 56 | 3 | 3 | 270 | 330 | 530 000 | 820 000 | 2 200 | — | 1 600 |
| | 440 | 72 | 4 | 4 | — | 385 | 935 000 | 1 340 000 | 1 600 | — | 1 300 |
| | 440 | 72 | 4 | 4 | 295 | — | 935 000 | 1 340 000 | 1 600 | — | 1 300 |
| | 440 | 120 | 4 | 4 | 295 | — | 1 440 000 | 2 320 000 | 1 500 | — | 1 200 |
| | 500 | 95 | 5 | 5 | — | 430 | 1 360 000 | 1 820 000 | 1 200 | — | 1 100 |
| | 500 | 95 | 5 | 5 | 310 | — | 1 360 000 | 1 820 000 | 1 200 | — | 1 100 |
| **260** | 400 | 65 | 4 | 4 | 296 | 364 | 645 000 | 1 000 000 | 1 900 | — | 1 500 |
| | 480 | 80 | 5 | 5 | — | 420 | 1 100 000 | 1 580 000 | 1 500 | — | 1 200 |
| | 480 | 80 | 5 | 5 | 320 | — | 1 100 000 | 1 580 000 | 1 500 | — | 1 200 |
| | 480 | 130 | 5 | 5 | 320 | — | 1 710 000 | 2 770 000 | 1 300 | — | 1 100 |
| | 540 | 102 | 6 | 6 | 336 | — | 1 540 000 | 2 090 000 | 1 100 | — | 1 000 |
| **280** | 420 | 65 | 4 | 4 | 316 | 384 | 660 000 | 1 050 000 | 1 800 | — | 1 400 |
| | 500 | 80 | 5 | 5 | — | 440 | 1 140 000 | 1 680 000 | 1 300 | — | 1 100 |
| | 500 | 80 | 5 | 5 | 340 | — | 1 140 000 | 1 680 000 | 1 300 | — | 1 100 |
| **300** | 460 | 74 | 4 | 4 | 340 | 420 | 885 000 | 1 400 000 | 1 600 | — | 1 300 |
| | 540 | 85 | 5 | 5 | 364 | — | 1 400 000 | 2 070 000 | 1 200 | — | 1 100 |
| **320** | 480 | 74 | 4 | 4 | 360 | 440 | 905 000 | 1 470 000 | 1 500 | — | 1 200 |
| | 580 | 92 | 5 | 5 | — | 510 | 1 540 000 | 2 270 000 | 1 100 | — | 950 |
| | 580 | 92 | 5 | 5 | 390 | — | 1 540 000 | 2 270 000 | 1 100 | — | 950 |

**Notes** (1) (M) in the column of cage symbols are usually omitted from the bearing number.
(2) When L-Shaped thrust collars (See section for L-Shaped Thrust Collars starting on page **B175**) are used, the bearings become the NH type.



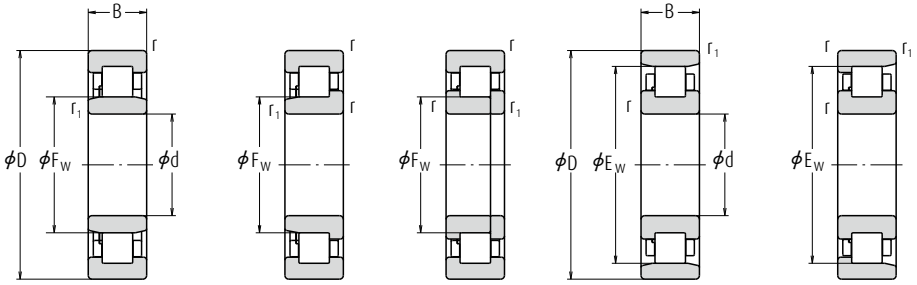




| Bearing Numbers | | | | | | | | Abutment and Fillet Dimensions (mm) | | | | | | | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cage symbol (1) Standard option | | NU | (2) NJ | NUP | N | NF | $d_a$(3) min. | $d_b$ min. | $d_b$(4) max. | $d_c$ min. | $d_d$ min. | $D_a$(3) max. | $D_b$ max. | $D_b$ min. | $r_a$ max. | $r_b$ max. | approx. |
| NU 1040 | (M) | — | NU | NJ | — | N | NF | 211 | 211 | 226 | 233 | — | 299 | 299 | 284 | 2 | 2 | 14 |
| N 240 | M | — | — | — | — | N | NF | 216 | — | — | — | — | — | 344 | 323 | 3 | 3 | 26.2 |
| NU 240 E* | M | — | NU | NJ | NUP | — | — | 216 | 216 | 238 | 247 | 261 | 344 | — | — | 3 | 3 | 27.4 |
| NU 2240 E* | M | — | NU | NJ | NUP | — | — | 216 | 216 | 235 | 247 | 261 | 344 | — | — | 3 | 3 | 46.1 |
| N 340 | M | — | — | — | — | N | NF | 220 | — | — | — | — | — | 400 | 367 | 4 | 4 | 55.3 |
| NU 340 E | M | — | NU | NJ | NUP | — | — | 220 | 220 | 252 | 263 | 283 | 400 | — | — | 4 | 4 | 57.1 |
| NU 2340 E | M | — | NU | NJ | NUP | — | — | 220 | 220 | 247 | 263 | 283 | 400 | — | — | 4 | 4 | 99.3 |
| NU 1044 | (M) | — | NU | NJ | — | N | — | 233 | 233 | 247 | 254 | — | 327 | 327 | 313 | 2.5 | 2.5 | 18.2 |
| N 244 | M | — | — | — | — | N | NF | 236 | — | — | — | — | — | 384 | 357 | 3 | 3 | 37 |
| NU 244 E* | M | — | NU | NJ | NUP | — | — | 236 | 236 | 264 | 273 | 289 | 384 | — | — | 3 | 3 | 37.3 |
| NU 2244 | M | — | NU | — | — | — | — | — | 236 | 264 | 273 | 289 | 384 | — | — | 3 | 3 | 61.8 |
| N 344 | M | — | — | — | — | N | — | 240 | — | — | — | — | — | 440 | 403 | 4 | 4 | 72.8 |
| NU 344 | M | — | NU | NJ | — | — | — | 240 | 240 | 278 | 287 | 307 | 440 | — | — | 4 | 4 | 74.6 |
| NU 1048 | (M) | — | NU | NJ | — | N | — | 253 | 253 | 266 | 275 | — | 347 | 347 | 333 | 2.5 | 2.5 | 19.5 |
| N 248 | M | — | — | — | — | N | NF | 256 | — | — | — | — | — | 424 | 392 | 3 | 3 | 49.6 |
| NU 248 | M | — | NU | NJ | NUP | — | — | 256 | 256 | 289 | 298 | 316 | 424 | — | — | 3 | 3 | 50.4 |
| NU 2248 | M | — | NU | — | — | — | — | — | 256 | 289 | 298 | 316 | 424 | — | — | 3 | 3 | 84.9 |
| N 348 | M | — | — | — | — | N | — | 260 | — | — | — | — | — | 480 | 438 | 4 | 4 | 92.3 |
| NU 348 | M | — | NU | NJ | — | — | — | 260 | 260 | 304 | 313 | 333 | 480 | — | — | 4 | 4 | 94.6 |
| NU 1052 | (M) | — | NU | NJ | — | N | NF | 276 | 276 | 292 | 300 | — | 384 | 384 | 367 | 3 | 3 | 29.1 |
| N 252 | M | — | — | — | — | N | — | 280 | — | — | — | — | — | 460 | 428 | 4 | 4 | 66.2 |
| NU 252 | M | — | NU | NJ | — | — | — | 280 | 280 | 314 | 323 | 343 | 460 | — | — | 4 | 4 | 67.1 |
| NU 2252 | M | — | NU | — | NUP | — | — | 280 | 280 | 314 | 323 | 343 | 460 | — | — | 4 | 4 | 111 |
| NU 352 | M | — | NU | NJ | — | — | — | 286 | 286 | 330 | 339 | 359 | 514 | — | — | 5 | 5 | 118 |
| NU 1056 | (M) | — | NU | NJ | NUP | N | NF | 296 | 296 | 312 | 320 | — | 404 | 404 | 387 | 3 | 3 | 30.8 |
| N 256 | M | — | — | — | — | N | NF | 300 | — | — | — | — | — | 480 | 448 | 4 | 4 | 69.6 |
| NU 256 | M | — | NU | NJ | — | — | — | 300 | 300 | 334 | 344 | 364 | 480 | — | — | 4 | 4 | 70.7 |
| NU 1060 | (M) | — | NU | NJ | — | N | NF | 316 | 316 | 336 | 344 | — | 444 | 444 | 424 | 3 | 3 | 43.7 |
| NU 260 | M | — | NU | NJ | — | — | — | 320 | 320 | 358 | 368 | 391 | 520 | — | — | 4 | 4 | 89.2 |
| NU 1064 | (M) | — | NU | — | — | N | NF | 336 | 336 | 356 | 365 | — | 464 | 464 | 444 | 3 | 3 | 46.1 |
| N 264 | M | — | — | — | — | N | — | 340 | — | — | — | — | — | 560 | 519 | 4 | 4 | 110 |
| NU 264 | M | — | NU | NJ | — | — | — | 340 | 340 | 384 | 394 | 420 | 560 | — | — | 4 | 4 | 112 |

**Notes** (3) If axial loads are applied, increase $d_a$ and reduce $D_a$ from the values listed above.
(4) $d_b$ (max.) are values for adjusting rings for NU, NJ Types.
(5) The limiting speeds (mechanical) in the bearing tables are the value for the standard cage type.

**Remark** The bearings denoted by an asterisk (*) are NSKHPS Cylindrical roller bearings.

## Bore Diameter 340 – 500 mm

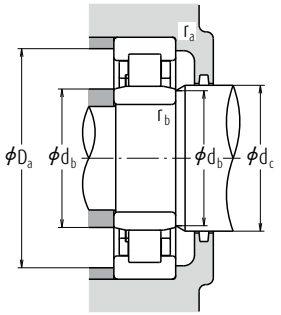


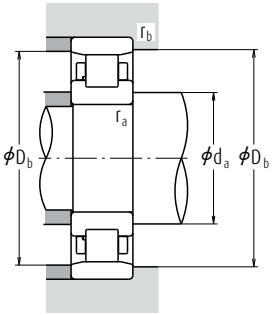

| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Speeds (min⁻¹) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Limiting Speeds | |
| d | D | B | r min. | r1 min. | Fw | Ew | Cr | C0r | Thermal Reference Speed | Mechanical (5) | Grease |
| **340** | 520 | 82 | 5 | 5 | 385 | 475 | 1 080 000 | 1 740 000 | 1 400 | – | 1 100 |
| **360** | 540 | 82 | 5 | 5 | 405 | 495 | 1 110 000 | 1 830 000 | 1 300 | – | 1 000 |
| **380** | 560 | 82 | 5 | 5 | 425 | – | 1 140 000 | 1 910 000 | 1 200 | – | 1 000 |
| **400** | 600 | 90 | 5 | 5 | 450 | 550 | 1 360 000 | 2 280 000 | 1 100 | – | 900 |
| **420** | 620 | 90 | 5 | 5 | 470 | 570 | 1 390 000 | 2 380 000 | 1 100 | – | 850 |
| **440** | 650 | 94 | 6 | 6 | 493 | – | 1 470 000 | 2 530 000 | 1 000 | – | 800 |
| **460** | 680 | 100 | 6 | 6 | 516 | 624 | 1 580 000 | 2 740 000 | 950 | – | 750 |
| **480** | 700 | 100 | 6 | 6 | 536 | 644 | 1 620 000 | 2 860 000 | 900 | – | 750 |
| **500** | 720 | 100 | 6 | 6 | 556 | 664 | 1 660 000 | 2 970 000 | 900 | – | 710 |

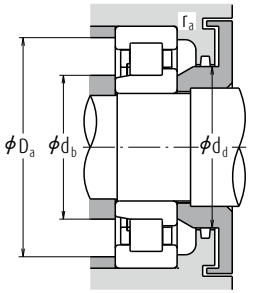
**Notes**

(1) (M) in the column of cage symbols are usually omitted from the bearing number.

(2) When L-Shaped thrust collars (See section for L-Shaped Thrust Collars starting on page **B175**) are used, the bearings become the NH type.



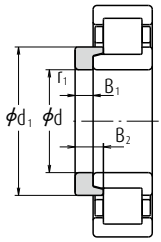




| Bearing Numbers | | | | | | | | Abutment and Fillet Dimensions (mm) | | | | | | | | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cage symbol (1) Standard option | | NU | (2) NJ | NUP | N | NF | $d_a$(3) min. | $d_b$ min. | $d_b$(4) max. | $d_c$ min. | $d_d$ min. | $D_a$(3) max. | $D_b$ max. | $D_b$ min. | $r_a$ max. | $r_b$ max. | approx. |
| **NU 1068** | **(M)** | — | **NU** | **NJ** | — | **N** | **NF** | 360 | 360 | 381 | 390 | — | 500 | 500 | 479 | 4 | 4 | 61.8 |
| **NU 1072** | **(M)** | — | **NU** | — | — | **N** | **NF** | 380 | 380 | 400 | 410 | — | 520 | 520 | 499 | 4 | 4 | 64.6 |
| **NU 1076** | **(M)** | — | **NU** | — | — | — | — | — | 400 | 420 | 430 | — | 540 | — | — | 4 | 4 | 67.5 |
| **NU 1080** | **(M)** | — | **NU** | — | **NUP** | **N** | — | 420 | 420 | 445 | 455 | — | 580 | 580 | 554.5 | 4 | 4 | 88.2 |
| **NU 1084** | **(M)** | — | **NU** | — | — | **N** | — | 440 | 440 | 465 | 475 | — | 600 | 600 | 574.5 | 4 | 4 | 91.7 |
| **NU 1088** | **(M)** | — | **NU** | — | — | — | — | — | 466 | 488 | 498 | — | 624 | — | — | 5 | 5 | 105 |
| **NU 1092** | **(M)** | — | **NU** | — | **NUP** | **N** | — | 486 | 486 | 511 | 521 | — | 654 | 654 | 628.5 | 5 | 5 | 123 |
| **NU 1096** | **(M)** | — | **NU** | **NJ** | — | **N** | — | 506 | 506 | 531 | 541 | — | 674 | 674 | 654 | 5 | 5 | 127 |
| **NU10/500** | **(M)** | — | **NU** | — | — | **N** | — | 526 | 526 | 551 | 558 | — | 694 | 694 | 674 | 5 | 5 | 131 |

**Notes**
(3) If axial loads are applied, increase $d_a$ and reduce $D_a$ from the values listed above.
(4) $d_b$ (max.) are values for adjusting rings for NU, NJ Types.
(5) The limiting speeds (mechanical) in the bearing tables are the value for the standard cage type.

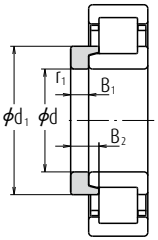
## L-Shaped Thrust Collars
## Bore Diameter 20 – 85 mm




L-Shaped Thrust Collar

| Boundary Dimensions (mm) | | | | | Thrust Collar Numbers | Mass (kg) |
|---|---|---|---|---|---|---|
| d | $d_1$ | $B_1$ | $B_2$ | $r_1$ min. | | approx. |
| **20** | 30 | 3 | 6.75 | 0.6 | **HJ 204** | 0.012 |
| | 29.8 | 3 | 5.5 | 0.6 | **HJ 204 E** | 0.011 |
| | 30 | 3 | 7.5 | 0.6 | **HJ 2204** | 0.012 |
| | 29.8 | 3 | 6.5 | 0.6 | **HJ 2204 E** | 0.012 |
| | 31.7 | 4 | 7.5 | 0.6 | **HJ 304** | 0.017 |
| | 31.4 | 4 | 6.5 | 0.6 | **HJ 304 E** | 0.017 |
| | 31.8 | 4 | 8.5 | 0.6 | **HJ 2304** | 0.017 |
| | 31.4 | 4 | 7.5 | 0.6 | HJ 2304 E | 0.018 |
| **25** | 34.8 | 3 | 6 | 0.6 | **HJ 205 E** | 0.014 |
| | 34.8 | 3 | 6.5 | 0.6 | **HJ 2205 E** | 0.014 |
| | 38.2 | 4 | 7 | 1.1 | **HJ 305 E** | 0.025 |
| | 38.2 | 4 | 8 | 1.1 | HJ 2305 E | 0.026 |
| | 43.6 | 6 | 10.5 | 1.5 | **HJ 405** | 0.057 |
| **30** | 41.3 | 4 | 7 | 0.6 | **HJ 206 E** | 0.025 |
| | 41.4 | 4 | 7.5 | 0.6 | **HJ 2206 E** | 0.025 |
| | 45.1 | 5 | 8.5 | 1.1 | **HJ 306 E** | 0.042 |
| | 45.1 | 5 | 9.5 | 1.1 | HJ 2306 E | 0.043 |
| | 50.5 | 7 | 11.5 | 1.5 | **HJ 406** | 0.080 |
| **35** | 48.2 | 4 | 7 | 0.6 | **HJ 207 E** | 0.033 |
| | 48.2 | 4 | 8.5 | 0.6 | **HJ 2207 E** | 0.035 |
| | 51.1 | 6 | 9.5 | 1.1 | **HJ 307 E** | 0.060 |
| | 51.1 | 6 | 11 | 1.1 | HJ 2307 E | 0.062 |
| | 59 | 8 | 13 | 1.5 | **HJ 407** | 0.12 |
| **40** | 54.1 | 5 | 8.5 | 1.1 | **HJ 208 E** | 0.049 |
| | 54.1 | 5 | 9 | 1.1 | **HJ 2208 E** | 0.050 |
| | 57.6 | 7 | 11 | 1.5 | **HJ 308 E** | 0.088 |
| | 57.7 | 7 | 12.5 | 1.5 | HJ 2308 E | 0.091 |
| | 64.8 | 8 | 13 | 2 | **HJ 408** | 0.14 |
| **45** | 59.1 | 5 | 8.5 | 1.1 | **HJ 209 E** | 0.055 |
| | 59.1 | 5 | 9 | 1.1 | **HJ 2209 E** | 0.055 |
| | 64.5 | 7 | 11.5 | 1.5 | **HJ 309 E** | 0.11 |
| | 64.5 | 7 | 13 | 1.5 | HJ 2309 E | 0.113 |
| | 71.7 | 8 | 13.5 | 2 | **HJ 409** | 0.175 |
| **50** | 64.1 | 5 | 9 | 1.1 | **HJ 210 E** | 0.061 |
| | 64.1 | 5 | 9 | 1.1 | **HJ 2210 E** | 0.061 |
| | 71.4 | 8 | 13 | 2 | **HJ 310 E** | 0.151 |
| | 71.4 | 8 | 14.5 | 2 | HJ 2310 E | 0.155 |
| | 78.8 | 9 | 14.5 | 2.1 | **HJ 410** | 0.23 |

| Boundary Dimensions (mm) | | | | | Thrust Collar Numbers | Mass (kg) |
|---|---|---|---|---|---|---|
| d | $d_1$ | $B_1$ | $B_2$ | $r_1$ min. | | approx. |
| **55** | 70.9 | 6 | 9.5 | 1.1 | **HJ 211 E** | 0.087 |
| | 70.9 | 6 | 10 | 1.1 | **HJ 2211 E** | 0.088 |
| | 77.6 | 9 | 14 | 2 | **HJ 311 E** | 0.195 |
| | 77.6 | 9 | 15.5 | 2 | HJ 2311 E | 0.20 |
| | 85.2 | 10 | 16.5 | 2.1 | **HJ 411** | 0.29 |
| **60** | 77.7 | 6 | 10 | 1.5 | **HJ 212 E** | 0.108 |
| | 77.7 | 6 | 10 | 1.5 | **HJ 2212 E** | 0.108 |
| | 84.5 | 9 | 14.5 | 2.1 | **HJ 312 E** | 0.231 |
| | 84.5 | 9 | 16 | 2.1 | HJ 2312 E | 0.237 |
| | 91.8 | 10 | 16.5 | 2.1 | **HJ 412** | 0.34 |
| **65** | 84.5 | 6 | 10 | 1.5 | HJ 213 E | 0.129 |
| | 84.5 | 6 | 10.5 | 1.5 | HJ 2213 E | 0.131 |
| | 90.6 | 10 | 15.5 | 2.1 | HJ 313 E | 0.288 |
| | 90.6 | 10 | 18 | 2.1 | HJ 2313 E | 0.298 |
| | 98.5 | 11 | 18 | 2.1 | **HJ 413** | 0.42 |
| **70** | 89.5 | 7 | 11 | 1.5 | HJ 214 E | 0.157 |
| | 89.5 | 7 | 11.5 | 1.5 | HJ 2214 E | 0.158 |
| | 97.5 | 10 | 15.5 | 2.1 | HJ 314 E | 0.33 |
| | 97.5 | 10 | 18.5 | 2.1 | HJ 2314 E | 0.345 |
| | 110.5 | 12 | 20 | 3 | **HJ 414** | 0.605 |
| **75** | 94.5 | 7 | 11 | 1.5 | HJ 215 E | 0.166 |
| | 94.5 | 7 | 11.5 | 1.5 | HJ 2215 E | 0.167 |
| | 104.2 | 11 | 16.5 | 2.1 | HJ 315 E | 0.41 |
| | 104.2 | 11 | 19.5 | 2.1 | HJ 2315 E | 0.43 |
| | 116 | 13 | 21.5 | 3 | **HJ 415** | 0.71 |
| **80** | 101.6 | 8 | 12.5 | 2 | HJ 216 E | 0.222 |
| | 101.6 | 8 | 12.5 | 2 | HJ 2216 E | 0.222 |
| | 110.6 | 11 | 17 | 2.1 | HJ 316 E | 0.46 |
| | 110.6 | 11 | 20 | 2.1 | HJ 2316 E | 0.48 |
| | 122 | 13 | 22 | 3 | **HJ 416** | 0.78 |
| **85** | 107.6 | 8 | 12.5 | 2 | HJ 217 E | 0.25 |
| | 107.6 | 8 | 13 | 2 | HJ 2217 E | 0.252 |
| | 117.9 | 12 | 18.5 | 3 | HJ 317 E | 0.575 |
| | 117.9 | 12 | 22 | 3 | HJ 2317 E | 0.595 |
| | 126 | 14 | 24 | 4 | **HJ 417** | 0.88 |

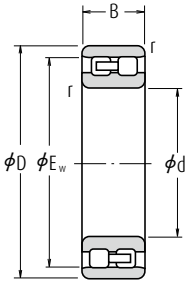



L-Shaped Thrust Collar

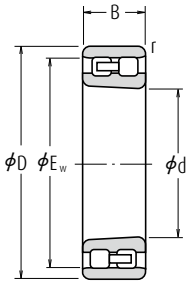
| Boundary Dimensions (mm) | | | | | Thrust Collar Numbers | Mass (kg) |
|---|---|---|---|---|---|---|
| d | $d_1$ | $B_1$ | $B_2$ | $r_1$ min. | | approx. |
| **90** | 114.3 | 9 | 14 | 2 | HJ 218 E | 0.32 |
| | 114.3 | 9 | 15 | 2 | HJ 2218 E | 0.325 |
| | 124.2 | 12 | 18.5 | 3 | HJ 318 E | 0.63 |
| | 124.2 | 12 | 22 | 3 | HJ 2318 E | 0.66 |
| | 137 | 14 | 24 | 4 | **HJ 418** | 1.05 |
| **95** | 120.6 | 9 | 14 | 2.1 | HJ 219 E | 0.355 |
| | 120.6 | 9 | 15.5 | 2.1 | HJ 2219 E | 0.365 |
| | 132.2 | 13 | 20.5 | 3 | HJ 319 E | 0.785 |
| | 132.2 | 13 | 24.5 | 3 | HJ 2319 E | 0.815 |
| | 147 | 15 | 25.5 | 4 | **HJ 419** | 1.3 |
| **100** | 127.5 | 10 | 15 | 2.1 | HJ 220 E | 0.44 |
| | 127.5 | 10 | 16 | 2.1 | HJ 2220 E | 0.45 |
| | 139.6 | 13 | 20.5 | 3 | HJ 320 E | 0.89 |
| | 139.6 | 13 | 23.5 | 3 | HJ 2320 E | 0.92 |
| | 153.5 | 16 | 27 | 4 | **HJ 420** | 1.5 |
| **105** | 145 | 13 | 20.5 | 3 | **HJ 321 E** | 0.97 |
| | 159.5 | 16 | 27 | 4 | **HJ 421** | 1.65 |
| **110** | 141.7 | 11 | 17 | 2.1 | HJ 222 E | 0.62 |
| | 141.7 | 11 | 19.5 | 2.1 | HJ 2222 E | 0.645 |
| | 155.8 | 14 | 22 | 3 | HJ 322 E | 1.21 |
| | 155.8 | 14 | 26.5 | 3 | HJ 2322 E | 1.27 |
| | 171 | 17 | 29.5 | 4 | **HJ 422** | 2.1 |
| **120** | 153.4 | 11 | 17 | 2.1 | HJ 224 E | 0.71 |
| | 153.4 | 11 | 20 | 2.1 | HJ 2224 E | 0.745 |
| | 168.6 | 14 | 22.5 | 3 | HJ 324 E | 1.41 |
| | 168.6 | 14 | 26 | 3 | HJ 2324 E | 1.46 |
| | 188 | 17 | 30.5 | 5 | **HJ 424** | 2.6 |
| **130** | 164.2 | 11 | 17 | 3 | HJ 226 E | 0.79 |
| | 164.2 | 11 | 21 | 3 | HJ 2226 E | 0.84 |
| | 182.3 | 14 | 23 | 4 | HJ 326 E | 1.65 |
| | 182.3 | 14 | 28 | 4 | HJ 2326 E | 1.73 |
| | 205 | 18 | 32 | 5 | **HJ 426** | 3.3 |
| **140** | 180 | 11 | 18 | 3 | HJ 228 E | 0.99 |
| | 180 | 11 | 23 | 3 | HJ 2228 E | 1.07 |
| | 196 | 15 | 25 | 4 | HJ 328 E | 2.04 |
| | 196 | 15 | 31 | 4 | HJ 2328 E | 2.14 |
| | 219 | 18 | 33 | 5 | **HJ 428** | 3.75 |

| Boundary Dimensions (mm) | | | | | Thrust Collar Numbers | Mass (kg) |
|---|---|---|---|---|---|---|
| d | $d_1$ | $B_1$ | $B_2$ | $r_1$ min. | | approx. |
| **150** | 193.7 | 12 | 19.5 | 3 | HJ 230 E | 1.26 |
| | 193.7 | 12 | 24.5 | 3 | HJ 2230 E | 1.35 |
| | 210 | 15 | 25 | 4 | HJ 330 E | 2.35 |
| | 210 | 15 | 31.5 | 4 | HJ 2330 E | 2.48 |
| | 234 | 20 | 36.5 | 5 | **HJ 430** | 4.7 |
| **160** | 207.3 | 12 | 20 | 3 | HJ 232 E | 1.48 |
| | 206.1 | 12 | 24.5 | 3 | HJ 2232 E | 1.55 |
| | 222 | 15 | 25 | 4 | HJ 332 E | 2.59 |
| | 222.1 | 15 | 32 | 4 | HJ 2332 E | 2.76 |
| **170** | 220.8 | 12 | 20 | 4 | HJ 234 E | 1.7 |
| | 219.5 | 12 | 24 | 4 | HJ 2234 E | 1.79 |
| | 238 | 16 | 33.5 | 4 | **HJ 2334 E** | 3.25 |
| **180** | 230.8 | 12 | 20 | 4 | HJ 236 E | 1.79 |
| | 229.5 | 12 | 24 | 4 | HJ 2236 E | 1.88 |
| | 252 | 17 | 35 | 4 | **HJ 2336 E** | 3.85 |
| **190** | 244.5 | 13 | 21.5 | 4 | HJ 238 E | 2.19 |
| | 243.2 | 13 | 26.5 | 4 | HJ 2238 E | 2.31 |
| | 260.6 | 18 | 36.5 | 5 | **HJ 2338 E** | 4.45 |
| **200** | 258.2 | 14 | 23 | 4 | HJ 240 E | 2.65 |
| | 258 | 14 | 34 | 4 | **HJ 2240** | 2.6 |
| | 256.9 | 14 | 28 | 4 | HJ 2240 E | 2.78 |
| | 280 | 18 | 30 | 5 | **HJ 340 E** | 5.0 |
| **220** | 286 | 15 | 27.5 | 4 | **HJ 244** | 3.55 |
| | 286 | 15 | 36.5 | 4 | **HJ 2244** | 3.55 |
| | 307 | 20 | 36 | 5 | **HJ 344** | 7.05 |
| **240** | 313 | 16 | 29.5 | 4 | **HJ 248** | 4.65 |
| | 313 | 16 | 38.5 | 4 | **HJ 2248** | 4.65 |
| | 334 | 22 | 39.5 | 5 | **HJ 348** | 8.2 |
| **260** | 340 | 18 | 33 | 5 | **HJ 252** | 6.2 |
| | 340 | 18 | 40.5 | 5 | **HJ 2252** | 6.2 |
| | 362 | 24 | 43 | 6 | **HJ 352** | 11.4 |
| **280** | 360 | 18 | 33 | 5 | **HJ 256** | 7.4 |
| **300** | 387 | 20 | 34.5 | 5 | **HJ 260** | 9.15 |
| **320** | 415 | 21 | 37 | 5 | **HJ 264** | 11.3 |

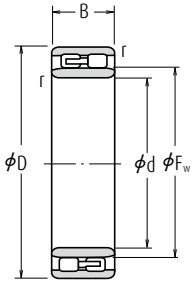
## Bore Diameter 25 – 140 mm



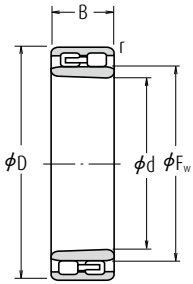

NN
Cylindrical Bore




NN
Tapered Bore




NNU
Cylindrical Bore

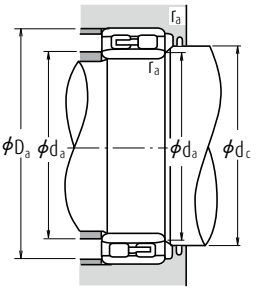


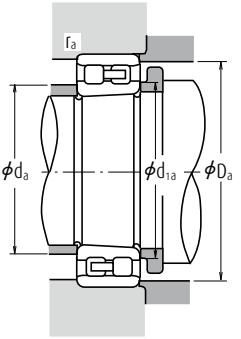

NNU
Tapered Bore

| Boundary Dimensions (mm) | | | | | | Basic Load Ratings (N) | | Limiting Speeds (min$^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|
| d | D | B | r min. | $F_w$ | $E_w$ | $C_r$ | $C_{0r}$ | Grease | Oil |
| **25** | 47 | 16 | 0.6 | – | 41.3 | 25 800 | 30 000 | 14 000 | 17 000 |
| **30** | 55 | 19 | 1 | – | 48.5 | 31 000 | 37 000 | 12 000 | 14 000 |
| **35** | 62 | 20 | 1 | – | 55 | 39 500 | 50 000 | 10 000 | 12 000 |
| **40** | 68 | 21 | 1 | – | 61 | 43 500 | 55 500 | 9 000 | 11 000 |
| **45** | 75 | 23 | 1 | – | 67.5 | 52 000 | 68 500 | 8 500 | 10 000 |
| **50** | 80 | 23 | 1 | – | 72.5 | 53 000 | 72 500 | 7 500 | 9 000 |
| **55** | 90 | 26 | 1.1 | – | 81 | 69 500 | 96 500 | 6 700 | 8 000 |
| **60** | 95 | 26 | 1.1 | – | 86.1 | 73 500 | 106 000 | 6 300 | 7 500 |
| **65** | 100 | 26 | 1.1 | – | 91 | 77 000 | 116 000 | 6 000 | 7 100 |
| **70** | 110 | 30 | 1.1 | – | 100 | 97 500 | 148 000 | 5 600 | 6 700 |
| **75** | 115 | 30 | 1.1 | – | 105 | 96 500 | 149 000 | 5 300 | 6 300 |
| **80** | 125 | 34 | 1.1 | – | 113 | 119 000 | 186 000 | 4 800 | 6 000 |
| **85** | 130 | 34 | 1.1 | – | 118 | 125 000 | 201 000 | 4 500 | 5 600 |
| **90** | 140 | 37 | 1.5 | – | 127 | 143 000 | 228 000 | 4 300 | 5 000 |
| **95** | 145 | 37 | 1.5 | – | 132 | 150 000 | 246 000 | 4 000 | 5 000 |
| **100** | 140 | 40 | 1.1 | 112 | – | 155 000 | 295 000 | 4 000 | 5 000 |
| | 150 | 37 | 1.5 | – | 137 | 157 000 | 265 000 | 4 000 | 4 800 |
| **105** | 145 | 40 | 1.1 | 117 | – | 161 000 | 315 000 | 3 800 | 4 800 |
| | 160 | 41 | 2 | – | 146 | 198 000 | 320 000 | 3 800 | 4 500 |
| **110** | 150 | 40 | 1.1 | 122 | – | 167 000 | 335 000 | 3 600 | 4 500 |
| | 170 | 45 | 2 | – | 155 | 229 000 | 375 000 | 3 400 | 4 300 |
| **120** | 165 | 45 | 1.1 | 133.5 | – | 183 000 | 360 000 | 3 200 | 4 000 |
| | 180 | 46 | 2 | – | 165 | 239 000 | 405 000 | 3 200 | 3 800 |
| **130** | 180 | 50 | 1.5 | 144 | – | 274 000 | 545 000 | 3 000 | 3 800 |
| | 200 | 52 | 2 | – | 182 | 284 000 | 475 000 | 3 000 | 3 600 |
| **140** | 190 | 50 | 1.5 | 154 | – | 283 000 | 585 000 | 2 800 | 3 600 |
| | 210 | 53 | 2 | – | 192 | 298 000 | 515 000 | 2 800 | 3 400 |

**Note** (1) The suffix KR represents bearings with tapered bores (taper 1 : 12).

**Remark** Production of double-row cylindrical roller bearings is generally in the high precision classes (Class 5 or better).

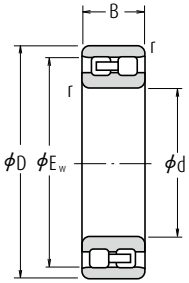


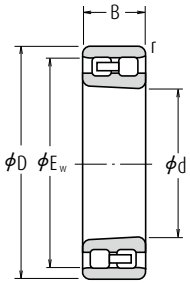

| Bearing Numbers | | Abutment and Fillet Dimensions (mm) | | | | | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|
| Cylindrical Bore | Tapered Bore (1) | $d_a$(2) min. | $d_a$(2) max. | $d_{1a}$ min. | $d_c$ min. | $D_a$ max. | $D_a$ min. | $r_a$ max. | approx. |
| NN 3005 | NN 3005 K | 29 | — | 29 | — | 43 | 42 | 0.6 | 0.127 |
| NN 3006 | NN 3006 K | 35 | — | 36 | — | 50 | 50 | 1 | 0.198 |
| NN 3007 | NN 3007 K | 40 | — | 41 | — | 57 | 56 | 1 | 0.258 |
| NN 3008 | NN 3008 K | 45 | — | 46 | — | 63 | 62 | 1 | 0.309 |
| NN 3009 | NN 3009 K | 50 | — | 51 | — | 70 | 69 | 1 | 0.407 |
| NN 3010 | NN 3010 K | 55 | — | 56 | — | 75 | 74 | 1 | 0.436 |
| NN 3011 | NN 3011 K | 61.5 | — | 62 | — | 83.5 | 83 | 1 | 0.647 |
| NN 3012 | NN 3012 K | 66.5 | — | 67 | — | 88.5 | 88 | 1 | 0.693 |
| NN 3013 | NN 3013 K | 71.5 | — | 72 | — | 93.5 | 93 | 1 | 0.741 |
| NN 3014 | NN 3014 K | 76.5 | — | 77 | — | 103.5 | 102 | 1 | 1.06 |
| NN 3015 | NN 3015 K | 81.5 | — | 82 | — | 108.5 | 107 | 1 | 1.11 |
| NN 3016 | NN 3016 K | 86.5 | — | 87 | — | 118.5 | 115 | 1 | 1.54 |
| NN 3017 | NN 3017 K | 91.5 | — | 92 | — | 123.5 | 120 | 1 | 1.63 |
| NN 3018 | NN 3018 K | 98 | — | 99 | — | 132 | 129 | 1.5 | 2.09 |
| NN 3019 | NN 3019 K | 103 | — | 104 | — | 137 | 134 | 1.5 | 2.19 |
| NNU 4920 | NNU 4920 K | 106.5 | 111 | 108 | 115 | 133.5 | — | 1 | 1.9 |
| NN 3020 | NN 3020 K | 108 | — | 109 | — | 142 | 139 | 1.5 | 2.28 |
| NNU 4921 | NNU 4921 K | 111.5 | 116 | 113 | 120 | 138.5 | — | 1 | 1.99 |
| NN 3021 | NN 3021 K | 114 | — | 115 | — | 151 | 148 | 2 | 2.88 |
| NNU 4922 | NNU 4922 K | 116.5 | 121 | 118 | 125 | 143.5 | — | 1 | 2.07 |
| NN 3022 | NN 3022 K | 119 | — | 121 | — | 161 | 157 | 2 | 3.71 |
| NNU 4924 | NNU 4924 K | 126.5 | 133 | 128 | 137 | 158.5 | — | 1 | 2.85 |
| NN 3024 | NN 3024 K | 129 | — | 131 | — | 171 | 167 | 2 | 4.04 |
| NNU 4926 | NNU 4926 K | 138 | 143 | 140 | 148 | 172 | — | 1.5 | 3.85 |
| NN 3026 | NN 3026 K | 139 | — | 141 | — | 191 | 185 | 2 | 5.88 |
| NNU 4928 | NNU 4928 K | 148 | 153 | 150 | 158 | 182 | — | 1.5 | 4.08 |
| NN 3028 | NN 3028 K | 149 | — | 151 | — | 201 | 195 | 2 | 6.34 |

**Note** (2) $d_a$ (max.) are values for adjusting rings for the NNU Type.

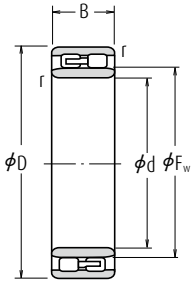
## Bore Diameter 150 – 360 mm



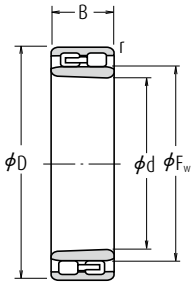

NN
Cylindrical Bore




NN
Tapered Bore




NNU
Cylindrical Bore

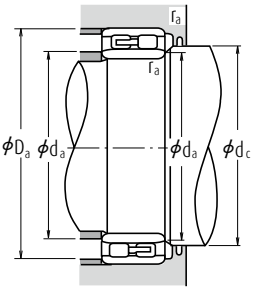


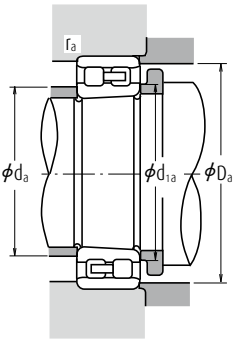

NNU
Tapered Bore

| Boundary Dimensions (mm) | | | | | | Basic Load Ratings (N) | | Limiting Speeds (min$^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|
| d | D | B | r min. | $F_w$ | $E_w$ | $C_r$ | $C_{0r}$ | Grease | Oil |
| **150** | 210 | 60 | 2 | 167 | – | 350 000 | 715 000 | 2 600 | 3 200 |
| | 225 | 56 | 2.1 | – | 206 | 335 000 | 585 000 | 2 600 | 3 000 |
| **160** | 220 | 60 | 2 | 177 | – | 365 000 | 760 000 | 2 400 | 3 000 |
| | 240 | 60 | 2.1 | – | 219 | 375 000 | 660 000 | 2 400 | 2 800 |
| **170** | 230 | 60 | 2 | 187 | – | 375 000 | 805 000 | 2 400 | 2 800 |
| | 260 | 67 | 2.1 | – | 236 | 450 000 | 805 000 | 2 200 | 2 600 |
| **180** | 250 | 69 | 2 | 200 | – | 480 000 | 1 020 000 | 2 200 | 2 600 |
| | 280 | 74 | 2.1 | – | 255 | 565 000 | 995 000 | 2 000 | 2 400 |
| **190** | 260 | 69 | 2 | 211.5 | – | 485 000 | 1 060 000 | 2 000 | 2 600 |
| | 290 | 75 | 2.1 | – | 265 | 595 000 | 1 080 000 | 2 000 | 2 400 |
| **200** | 280 | 80 | 2.1 | 223 | – | 570 000 | 1 220 000 | 1 900 | 2 400 |
| | 310 | 82 | 2.1 | – | 282 | 655 000 | 1 170 000 | 1 800 | 2 200 |
| **220** | 300 | 80 | 2.1 | 243 | – | 600 000 | 1 330 000 | 1 700 | 2 200 |
| | 340 | 90 | 3 | – | 310 | 815 000 | 1 480 000 | 1 700 | 2 000 |
| **240** | 320 | 80 | 2.1 | 263 | – | 625 000 | 1 450 000 | 1 600 | 2 000 |
| | 360 | 92 | 3 | – | 330 | 855 000 | 1 600 000 | 1 500 | 1 800 |
| **260** | 360 | 100 | 2.1 | 289 | – | 935 000 | 2 100 000 | 1 400 | 1 800 |
| | 400 | 104 | 4 | – | 364 | 1 030 000 | 1 920 000 | 1 400 | 1 700 |
| **280** | 380 | 100 | 2.1 | 309 | – | 960 000 | 2 230 000 | 1 300 | 1 700 |
| | 420 | 106 | 4 | – | 384 | 1 080 000 | 2 080 000 | 1 300 | 1 500 |
| **300** | 420 | 118 | 3 | 336 | – | 1 230 000 | 2 870 000 | 1 200 | 1 500 |
| | 460 | 118 | 4 | – | 418 | 1 290 000 | 2 460 000 | 1 200 | 1 400 |
| **320** | 440 | 118 | 3 | 356 | – | 1 260 000 | 3 050 000 | 1 100 | 1 400 |
| | 480 | 121 | 4 | – | 438 | 1 350 000 | 2 670 000 | 1 100 | 1 300 |
| **340** | 520 | 133 | 5 | – | 473 | 1 670 000 | 3 300 000 | 1 000 | 1 200 |
| **360** | 540 | 134 | 5 | – | 493 | 1 700 000 | 3 450 000 | 950 | 1 200 |

**Note** (1) The suffix KR represents bearings with tapered bores (taper 1 : 12).

**Remark** Production of double-row cylindrical roller bearings is generally in the high precision classes (Class 5 or better).




| Bearing Numbers | | Abutment and Fillet Dimensions (mm) | | | | | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|
| Cylindrical Bore | Tapered Bore (1) | $d_a$(2) min. | $d_a$(2) max. | $d_{1a}$ min. | $d_c$ min. | $D_a$ max. | $D_a$ min. | $r_a$ max. | approx. |
| **NNU 4930** | **NNU 4930 K** | 159 | 166 | 162 | 171 | 201 | – | 2 | 6.39 |
| **NN 3030** | **NN 3030 K** | 161 | – | 162 | – | 214 | 209 | 2 | 7.77 |
| **NNU 4932** | **NNU 4932 K** | 169 | 176 | 172 | 182 | 211 | – | 2 | 6.76 |
| **NN 3032** | **NN 3032 K** | 171 | – | 172 | – | 229 | 222 | 2 | 9.41 |
| **NNU 4934** | **NNU 4934 K** | 179 | 186 | 182 | 192 | 221 | – | 2 | 7.12 |
| **NN 3034** | **NN 3034 K** | 181 | – | 183 | – | 249 | 239 | 2 | 12.8 |
| **NNU 4936** | **NNU 4936 K** | 189 | 199 | 193 | 205 | 241 | – | 2 | 10.4 |
| **NN 3036** | **NN 3036 K** | 191 | – | 193 | – | 269 | 258 | 2 | 16.8 |
| **NNU 4938** | **NNU 4938 K** | 199 | 211 | 203 | 217 | 251 | – | 2 | 10.9 |
| **NN 3038** | **NN 3038 K** | 201 | – | 203 | – | 279 | 268 | 2 | 17.8 |
| **NNU 4940** | **NNU 4940 K** | 211 | 222 | 214 | 228 | 269 | – | 2 | 15.3 |
| **NN 3040** | **NN 3040 K** | 211 | – | 214 | – | 299 | 285 | 2 | 22.7 |
| **NNU 4944** | **NNU 4944 K** | 231 | 242 | 234 | 248 | 289 | – | 2 | 16.6 |
| **NN 3044** | **NN 3044 K** | 233 | – | 236 | – | 327 | 313 | 2.5 | 29.6 |
| **NNU 4948** | **NNU 4948 K** | 251 | 262 | 254 | 269 | 309 | – | 2 | 18 |
| **NN 3048** | **NN 3048 K** | 253 | – | 256 | – | 347 | 334 | 2.5 | 32.7 |
| **NNU 4952** | **NNU 4952 K** | 271 | 288 | 275 | 295 | 349 | – | 2 | 31.1 |
| **NN 3052** | **NN 3052 K** | 276 | – | 278 | – | 384 | 368 | 3 | 47.7 |
| **NNU 4956** | **NNU 4956 K** | 291 | 308 | 295 | 315 | 369 | – | 2 | 33 |
| **NN 3056** | **NN 3056 K** | 296 | – | 298 | – | 404 | 388 | 3 | 51.1 |
| **NNU 4960** | **NNU 4960 K** | 313 | 335 | 318 | 343 | 407 | – | 2.5 | 51.9 |
| **NN 3060** | **NN 3060 K** | 316 | – | 319 | – | 444 | 422 | 3 | 70.7 |
| **NNU 4964** | **NNU 4964 K** | 333 | 355 | 338 | 363 | 427 | – | 2.5 | 54.9 |
| **NN 3064** | **NN 3064 K** | 336 | – | 340 | – | 464 | 442 | 3 | 76.6 |
| **NN 3068** | **NN 3068 K** | 360 | – | 365 | – | 500 | 477 | 4 | 102 |
| **NN 3072** | **NN 3072 K** | 380 | – | 385 | – | 520 | 497 | 4 | 106 |

**Note** (2) $d_a$ (max.) are values for adjusting rings for the NNU Type.

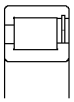
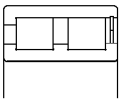
## FULL-COMPLEMENT CYLINDRICAL ROLLER BEARINGS
## SINGLE-ROW(NCF), DOUBLE-ROW(NNCF)

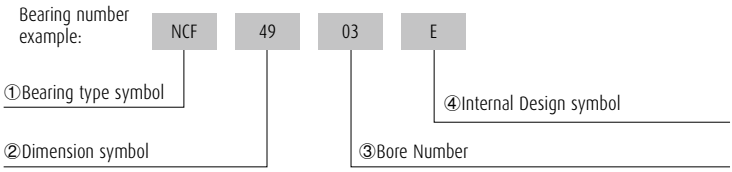
### DESIGN, TYPES, AND FEATURES

Cageless, full-complement cylindrical roller bearings have the maximum possible number of rollers and can sustain much heavier loads than cylindrical roller bearings of the same size with cages. On the other hand, high-speed capability is inferior to the bearings with cages.

The open-type single- and double-row bearings are mostly used in general industrial applications at low speed and under heavy load, and the shielded-type double-row bearings are often used in crane sheaves.

**Table 1 Features of Various Types**

| Figure | Type | Design and Features |
|---|---|---|
|  | NCF | The outer and inner rings and rollers are non-separable since a retaining snap ring is installed at the side opposite the outer ring rib. They can sustain axial loads in only one direction. |
|  | NNCF | NNCF is a double-row version of NCF. They can sustain heavy radial loads. |




①Bearing Type Symbol: NCF: Single Row Cylndrical Roller Bearing
NNCF: Double Row Cylindrical Roller Bearing
②Dimension Symbol: 18: 18 Series, 29: 29 Series, 30: 30 Series
49: 49 Series, 50: 50 Series
③Bore Number: Less than 03, Bearing bore 00 : 10 mm, 01 : 12 mm,
02 : 15 mm, 03 : 17 mm
Over 04, Bearing bore Bore number ×5 (mm)
④Internal Design Symbol: V: full complement

**TOLERANCES AND RUNNING ACCURACY** ..... Table 7.2 (Pages A128 to A131)

**Single-Row**
**Double-Row**

**RECOMMENDED FITS**

**Single-Row**
**Double-Row**

Inner Ring Rotation ..... Table 8.3 (Page A164)
Table 8.5 (Page A165)
Outer Ring Rotation ..... Table 2 below

## Table 2 Fits and Internal Clearances for Full-Complement Cylindrical Roller Bearings

| Operating Conditions | | Fitting between Inner Ring and Shaft | Fitting between Outer Ring and Housing Bore | Recommended Internal Clearance |
|---|---|---|---|---|
| Outer Ring Rotation | Thin walled housings and heavy loads | g6 or h6 | P7 | C3 |
| | Normal to heavy loads | g6 or h6 | N7 | C3 |
| | Light or fluctuating loads | g6 or h6 | M7 | CN |

## Permissible Misalignment

The permissible misalignment of full-complement single-row cylindrical roller bearings is generally 0.0006 radian (2′) under normal load. For double-row bearings, nearly no misalignment is allowed.

## FULL-COMPLEMENT CYLINDRICAL ROLLER BEARINGS FOR SHEAVES

### DESIGN, TYPES, AND FEATURES

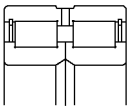
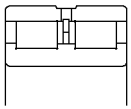
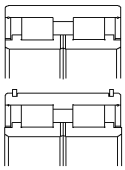
Cylindrical Roller Bearings for sheaves are specially designed thin-walled, broad-width, full-complement type double-row cylindrical roller bearings, but they are widely used also for general industrial machines running at low speed and under heavy loads. There are several series as shown in Table 1.

**Table 1 Series of Cylindrical Roller Bearings for Sheaves**

| Bearing Type | | Fixed-End | Free-End |
|---|---|---|---|
| Open Type | Without Snap Ring | RS-48E4<br>RS-49E4 | RSF-48E4<br>RSF-49E4 |
| Shielded Type | Without Snap Ring<br>With Snap Ring | RS-50<br>RS-50NR | — |

Since all are non-separable type bearings, the inner and outer rings cannot be separated, but the RSF type can be used as a free-end bearing. In this case, the permissible axial displacement is listed in the bearing tables. Since cylindrical roller bearings for sheaves are a double-row, full-complement type, they can withstand heavy shock loads and moments and have sufficient axial load capacity for use in sheaves. Since the shielded type is a kind of bearing unit, the number of parts surrounding the bearing can be reduced, so it allows for a simple compact design.
The surface of these bearings is treated for rust prevention.

**Table 1 Features of Various Types**

| Figure | Type | Design and Features |
|---|---|---|
|  | RS-48E4<br>RS-49E4 | Double-row outer ring with center rib, two single-row inner rings with ribs. The outer and inner rings and rollers are non-separable since there are two retaining snap rings at the sides of the outer ring. They can suntain an axial load in either direction so they can be used as fixed-end bearings. An oil groove and holes are provided at the center of the outer ring. |
|  | RSF-48E4<br>RSF-49E4 | Double-row outer ring without ribs, double-row inner ring with three ribs. The outer and inner rings and rollers are non-separable since there is a retaining snap ring at the middle of the outer ring. They can be used as free-end bearings. The permissible axial movement is listed in the dimensional tables. An oil groove and holes are provided at the center of the outer ring. |
|  | RS-50<br><br>RS-50NR | Both sides shielded, double-row outer ring with center rib, two inner rings with ribs. They can sustain an axial load in either direction. They are prelubricated, but it is possible to replenish the grease through an oil groove and holes in parts mating with the inner rings. If there are snap rings at the outside of the outer ring, this type becomes RS-50NR. They are surface-treated for rust prevention. |

## RECOMMENDED FITS AND INTERNAL CLEARANGES

When used with outer ring rotation for sheaves or wheels, the fit and radial internal clearance should conform to Table 3.

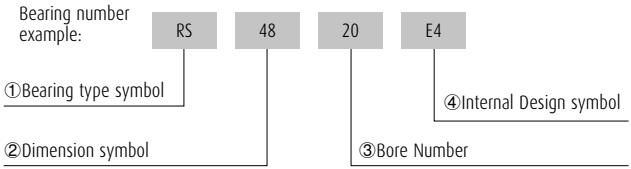
### Table 3 Fits and Internal Clearances for Cylindrical Roller Bearings for Sheaves

| Operating Conditions | | Fitting between Inner Ring and Shaft | Fitting between Outer Ring and Housing Bore | Recommended Internal Clearance |
|---|---|---|---|---|
| Outer Ring Rotation | Thin walled housings and heavy loads | g6 or h6 | P7 | C3 |
| | Normal to heavy loads | g6 or h6 | N7 | C3 |
| | Light or fluctuating loads | g6 or h6 | M7 | CN |

The fits listed in Tables 8.3 (Page A164) and 8.5 (Page A165) apply when they are used with inner ring rotation in general applications, and the internal clearance should conform to Table 4.

### Table 4

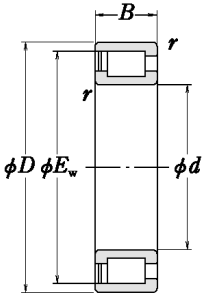
| Nominal Bore Dia. d (mm) | | Clearances | | | |
|---|---|---|---|---|---|
| | | CN | | C3 | |
| over | incl. | min. | max. | min. | max. |
| 30 | 40 | 15 | 50 | 35 | 70 |
| 40 | 50 | 20 | 55 | 40 | 75 |
| 50 | 65 | 20 | 65 | 45 | 90 |
| 65 | 80 | 25 | 75 | 55 | 105 |
| 80 | 100 | 30 | 80 | 65 | 115 |
| 100 | 120 | 35 | 90 | 80 | 135 |
| 120 | 140 | 40 | 105 | 90 | 155 |
| 140 | 160 | 50 | 115 | 100 | 165 |
| 160 | 180 | 60 | 125 | 110 | 175 |
| 180 | 200 | 65 | 135 | 125 | 195 |
| 200 | 225 | 75 | 150 | 140 | 215 |
| 225 | 250 | 90 | 165 | 155 | 230 |
| 250 | 280 | 100 | 180 | 175 | 255 |
| 280 | 315 | 110 | 195 | 195 | 280 |
| 315 | 355 | 125 | 215 | 215 | 305 |
| 355 | 400 | 140 | 235 | 245 | 340 |
| 400 | 450 | 155 | 275 | 270 | 390 |
| 450 | 500 | 180 | 300 | 300 | 420 |




①Bearing type Symbol: RS: Fixed End Bearing
RSF: Free End Bearing
②Dimension Symbol: 48: 48 Series, 49: 49 Series, 40: 50 Series
③Bore number: Less than 03, Bearing bore 00 : 10 mm, 01 : 12 mm,
02 : 15 mm, 03 : 17 mm
Over 04, Bearing bore Bore number ×5 (mm)
④Internal Design Symbol: E4: Lubrication grooves and holes in outerring

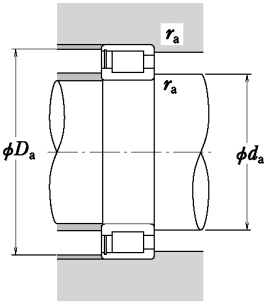
# Full-Complement Cylindrical Roller Bearings

## NCF Type, Single-Row
## Bore Diameter 100 – 260 mm




| Boundary Dimensions (mm) | | | | | Basic Load Ratings (kN) | | Bearing Numbers |
|---|---|---|---|---|---|---|---|
| d | D | B | r min. | $E_w$ | $C_r$ | $C_{0r}$ | |
| **100** | 140 | 24 | 1.1 | 130.5 | 132 | 209 | **NCF2920V** |
| | 150 | 37 | 1.5 | 139.7 | 209 | 310 | **NCF3020V** |
| **110** | 150 | 24 | 1.1 | 141 | 138 | 229 | **NCF2922V** |
| | 170 | 45 | 2 | 156.3 | 278 | 405 | **NCF3022V** |
| **120** | 165 | 27 | 1.1 | 154 | 177 | 305 | **NCF2924V** |
| | 180 | 46 | 2 | 167.58 | 293 | 440 | **NCF3024V** |
| **130** | 180 | 30 | 1.5 | 166.5 | 210 | 370 | **NCF2926V** |
| | 200 | 52 | 2 | 183.81 | 415 | 615 | **NCF3026V** |
| **140** | 190 | 30 | 1.5 | 179.4 | 227 | 395 | **NCF2928V** |
| | 210 | 53 | 2 | 197.82 | 435 | 680 | **NCF3028V** |
| **150** | 210 | 36 | 2 | 195 | 289 | 505 | **NCF2930V** |
| | 225 | 56 | 2.1 | 206.82 | 460 | 710 | **NCF3030V** |
| **160** | 220 | 36 | 2 | 207 | 310 | 535 | **NCF2932V** |
| | 240 | 60 | 2.1 | 224.8 | 520 | 810 | **NCF3032V** |
| **170** | 215 | 22 | 1.5 | 203.5 | 149 | 272 | **NCF1834V** |
| | 230 | 36 | 2 | 218 | 320 | 570 | **NCF2934V** |
| | 260 | 67 | 2.1 | 242.87 | 675 | 1 070 | **NCF3034V** |
| **180** | 225 | 22 | 1.5 | 215 | 154 | 290 | **NCF1836V** |
| | 250 | 42 | 2 | 231.5 | 390 | 695 | **NCF2936V** |
| | 280 | 74 | 2.1 | 260.3 | 785 | 1 260 | **NCF3036V** |
| **190** | 240 | 24 | 1.5 | 228.7 | 178 | 335 | **NCF1838V** |
| | 260 | 42 | 2 | 243.6 | 435 | 785 | **NCF2938V** |
| | 290 | 75 | 2.1 | 269.9 | 805 | 1 320 | **NCF3038V** |
| **200** | 250 | 24 | 1.5 | 237 | 182 | 350 | **NCF1840V** |
| | 280 | 48 | 2.1 | 261 | 530 | 955 | **NCF2940V** |
| | 310 | 82 | 2.1 | 287.8 | 910 | 1 510 | **NCF3040V** |
| **220** | 270 | 24 | 2 | 257.7 | 191 | 385 | **NCF1844V** |
| | 300 | 48 | 2.1 | 282 | 555 | 1 050 | **NCF2944V** |
| | 340 | 90 | 3 | 312.3 | 1 100 | 1 820 | **NCF3044V** |
| **240** | 300 | 28 | 2 | 283 | 236 | 470 | **NCF1848V** |
| | 320 | 48 | 2.1 | 303 | 580 | 1 140 | **NCF2948V** |
| | 360 | 92 | 3 | 335.25 | 1 160 | 1 990 | **NCF3048V** |
| **260** | 320 | 28 | 2 | 307 | 247 | 510 | **NCF1852V** |
| | 360 | 60 | 2.1 | 333.2 | 750 | 1 460 | **NCF2952V** |
| | 400 | 104 | 4 | 376.1 | 1 570 | 2 600 | **NCF3052V** |

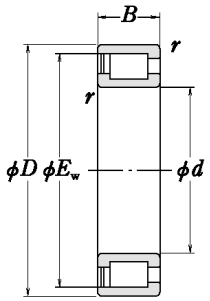
**Remark** Full-complement cylindrical roller bearings are designed for specific applications, when using them, please contact NSK.




| Abutment and Fillet Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|
| $d_a$ min. | $D_a$ max. | $r_a$ max. | approx. |
| 109 | 131 | 1 | 1.0 |
| 111 | 140 | 1.5 | 2.1 |
| 119 | 142 | 1 | 1.1 |
| 122 | 157 | 2 | 3.3 |
| 130 | 155 | 1 | 1.7 |
| 132 | 168 | 2 | 3.6 |
| 141 | 168 | 1.5 | 2.2 |
| 142 | 187 | 2 | 5.6 |
| 151 | 180 | 1.5 | 2.3 |
| 152 | 198 | 2 | 5.9 |
| 163 | 196 | 2 | 3.7 |
| 165 | 209 | 2 | 7.1 |
| 173 | 208 | 2 | 3.8 |
| 175 | 225 | 2 | 8.6 |
| 182 | 204 | 1.5 | 1.8 |
| 183 | 219 | 2 | 4.1 |
| 185 | 244 | 2 | 11.9 |
| 192 | 216 | 1.5 | 1.8 |
| 193 | 236 | 2 | 6.0 |
| 195 | 263 | 2 | 15.8 |
| 202 | 229 | 1.5 | 2.4 |
| 203 | 245 | 2 | 6.5 |
| 206 | 273 | 2 | 16.7 |
| 213 | 238 | 1.5 | 2.5 |
| 216 | 263 | 2 | 8.9 |
| 216 | 293 | 2 | 21.4 |
| 234 | 258 | 2 | 2.7 |
| 236 | 283 | 2 | 9.6 |
| 238 | 320 | 2.5 | 28.2 |
| 254 | 285 | 2 | 4.2 |
| 257 | 304 | 2 | 10.4 |
| 259 | 340 | 2.5 | 31.2 |
| 275 | 308 | 2 | 4.5 |
| 277 | 342 | 2 | 18.1 |
| 282 | 377 | 3 | 45.3 |

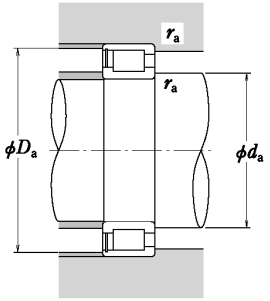
# Full-Complement Cylindrical Roller Bearings

## NCF Type, Single-Row
## Bore Diameter 300 – 800 mm



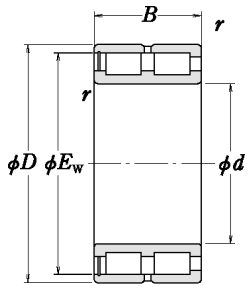

| Boundary Dimensions (mm) | | | | | Basic Load Ratings (kN) | | Bearing Numbers |
|---|---|---|---|---|---|---|---|
| d | D | B | r min. | $E_w$ | $C_r$ | $C_{0r}$ | |
| **300** | 380 | 38 | 2.5 | 359 | 445 | 870 | **NCF1860V** |
| | 420 | 72 | 3 | 389.6 | 1 120 | 2 220 | **NCF2960V** |
| | 460 | 118 | 4 | 341.7 | 1 980 | 3 500 | **NCF3060V** |
| **320** | 400 | 38 | 2.1 | 380 | 460 | 925 | **NCF1864V** |
| | 440 | 72 | 3 | 410 | 1 150 | 2 340 | **NCF2964V** |
| | 480 | 121 | 4 | 449.6 | 2 170 | 3 900 | **NCF3064V** |
| **340** | 420 | 38 | 2.1 | 401 | 475 | 985 | **NCF1868V** |
| | 460 | 72 | 3 | 430.3 | 1 190 | 2 470 | **NCF2968V** |
| | 520 | 133 | 5 | 485.8 | 2 480 | 4 350 | **NCF3068V** |
| **360** | 440 | 38 | 2.5 | 422 | 490 | 1 040 | **NCF1872V** |
| | 480 | 72 | 3 | 450.7 | 1 220 | 2 610 | **NCF2972V** |
| | 540 | 134 | 5 | 503.6 | 2 550 | 4 600 | **NCF3072V** |
| **380** | 480 | 46 | 2.5 | 452.8 | 575 | 1 230 | **NCF1876V** |
| | 520 | 82 | 4 | 486.7 | 1 600 | 3 350 | **NCF2976V** |
| | 560 | 135 | 5 | 521.4 | 2 610 | 4 800 | **NCF3076V** |
| **400** | 500 | 46 | 2.5 | 475.7 | 590 | 1 300 | **NCF1880V** |
| | 540 | 82 | 4 | 511 | 1 650 | 3 550 | **NCF2980V** |
| | 600 | 148 | 5 | 558.7 | 3 050 | 5 750 | **NCF3080AV** |
| **420** | 520 | 46 | 2.1 | 491 | 600 | 1 340 | **NCF1884V** |
| | 560 | 82 | 4 | 523.2 | 1 680 | 3 650 | **NCF2984V** |
| | 620 | 150 | 5 | 577.7 | 3 000 | 5 650 | **NCF3084V** |
| **440** | 540 | 46 | 2.1 | 514 | 615 | 1 410 | **NCF1888V** |
| | 600 | 95 | 4 | 562 | 2 070 | 4 300 | **NCF2988V** |
| **460** | 580 | 56 | 3 | 552.7 | 920 | 1 950 | **NCF1892V** |
| | 620 | 95 | 4 | 576.5 | 2 100 | 4 450 | **NCF2992V** |
| **480** | 600 | 56 | 3 | 573 | 940 | 2 040 | **NCF1896V** |
| | 650 | 100 | 5 | 615 | 2 380 | 5 100 | **NCF2996V** |
| **500** | 620 | 56 | 3 | 593.5 | 960 | 2 120 | **NCF18/500V** |
| | 670 | 100 | 5 | 630.2 | 2 420 | 5 250 | **NCF29/500V** |
| **530** | 650 | 56 | 3 | 624 | 990 | 2 240 | **NCF18/530V** |
| **560** | 680 | 56 | 3 | 654.7 | 1 020 | 2 360 | **NCF18/560V** |
| | 820 | 195 | 6 | 770 | 5 600 | 11 300 | **NCF30/560V** |
| **600** | 730 | 60 | 3 | 695.5 | 1 140 | 2 680 | **NCF18/600V** |
| | 800 | 118 | 5 | 752 | 3 050 | 7 300 | **NCF29/600V** |
| **630** | 780 | 69 | 4 | 742 | 1 470 | 3 400 | **NCF18/630V** |
| **670** | 820 | 69 | 4 | 780 | 1 520 | 3 550 | **NCF18/670V** |
| **710** | 870 | 74 | 4 | 832.5 | 1 650 | 3 900 | **NCF18/710V** |
| **750** | 920 | 78 | 4 | 882.3 | 1 930 | 4 600 | **NCF18/750V** |
| **800** | 980 | 82 | 5 | 936 | 2 110 | 5 100 | **NCF18/800V** |

**Remark** Full-complement cylindrical roller bearings are designed for specific applications, when using them, please contact NSK.



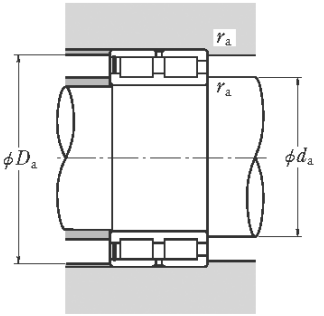

| Abutment and Fillet Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|
| $d_a$ min. | $D_a$ max. | $r_a$ max. | approx. |
| 319 | 360 | 2 | 9.7 |
| 320 | 398 | 2.5 | 30.7 |
| 323 | 435 | 3 | 67.6 |
| 338 | 381 | 2 | 10.3 |
| 340 | 418 | 2.5 | 33 |
| 343 | 454 | 3 | 73 |
| 359 | 402 | 2 | 10.7 |
| 361 | 438 | 2.5 | 34.1 |
| 368 | 490 | 4 | 97 |
| 380 | 423 | 2 | 11.5 |
| 381 | 457 | 2.5 | 36 |
| 388 | 509 | 4 | 102 |
| 400 | 458 | 2 | 18.6 |
| 404 | 493 | 3 | 52 |
| 408 | 529 | 4 | 108 |
| 421 | 478 | 2 | 19.5 |
| 425 | 513 | 3 | 53.4 |
| 429 | 568 | 4 | 139 |
| 440 | 498 | 2 | 20.5 |
| 445 | 533 | 3 | 55.7 |
| 449 | 588 | 4 | 147 |
| 461 | 518 | 2 | 21.3 |
| 466 | 572 | 3 | 78.2 |
| 483 | 555 | 2.5 | 32.5 |
| 486 | 591 | 3 | 81.2 |
| 503 | 575 | 2.5 | 33.8 |
| 510 | 617 | 4 | 95.1 |
| 524 | 594 | 2.5 | 35 |
| 531 | 637 | 4 | 98.4 |
| 554 | 625 | 2.5 | 36.9 |
| 585 | 655 | 2.5 | 39.3 |
| 598 | 778 | 5 | 332.5 |
| 626 | 702 | 2.5 | 48.9 |
| 633 | 764 | 4 | 164.9 |
| 659 | 748 | 3 | 68.8 |
| 700 | 787 | 3 | 72.7 |
| 741 | 836 | 3 | 87.6 |
| 786 | 883 | 4 | 103.3 |
| 832 | 950 | 4 | 123.1 |

## NNCF Type, Double-Row
## Bore Diameter 100 – 260 mm



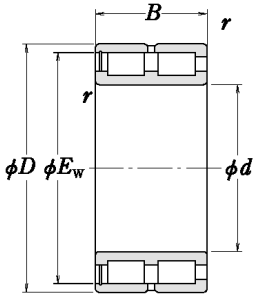

| Boundary Dimensions (mm) | | | | | Basic Load Ratings (kN) | | Bearing Numbers |
|---|---|---|---|---|---|---|---|
| d | D | B | r min. | $E_w$ | $C_r$ | $C_{0r}$ | |
| **100** | 140 | 40 | 1.1 | 129.8 | 194 | 400 | **NNCF4920V** |
| | 150 | 67 | 1.5 | 139.7 | 360 | 615 | **NNCF5020V** |
| **110** | 150 | 40 | 1.1 | 138.4 | 202 | 430 | **NNCF4922V** |
| | 170 | 80 | 2 | 156.3 | 490 | 840 | **NNCF5022V** |
| **120** | 165 | 45 | 1.1 | 153.8 | 226 | 480 | **NNCF4924V** |
| | 180 | 80 | 2 | 167.58 | 500 | 885 | **NNCF5024V** |
| **130** | 180 | 50 | 1.5 | 165.7 | 262 | 555 | **NNCF4926V** |
| | 200 | 95 | 2 | 183.81 | 710 | 1 230 | **NNCF5026V** |
| **140** | 190 | 50 | 1.5 | 176.2 | 272 | 595 | **NNCF4928V** |
| | 210 | 95 | 2 | 197.82 | 750 | 1 360 | **NNCF5028V** |
| **150** | 210 | 60 | 2 | 191.6 | 390 | 865 | **NNCF4930V** |
| | 225 | 100 | 2.1 | 206.82 | 785 | 1 420 | **NNCF5030V** |
| **160** | 220 | 60 | 2 | 204.1 | 410 | 930 | **NNCF4932V** |
| | 240 | 109 | 2.1 | 224.8 | 895 | 1 620 | **NNCF5032V** |
| **170** | 230 | 60 | 2 | 212.4 | 415 | 975 | **NNCF4934V** |
| | 260 | 122 | 2.1 | 242.87 | 1 160 | 2 140 | **NNCF5034V** |
| **180** | 250 | 69 | 2 | 230.5 | 550 | 1 230 | **NNCF4936V** |
| | 280 | 136 | 2.1 | 260.3 | 1 340 | 2 510 | **NNCF5036V** |
| **190** | 260 | 69 | 2 | 240.7 | 565 | 1 290 | **NNCF4938V** |
| | 290 | 136 | 2.1 | 269.9 | 1 380 | 2 630 | **NNCF5038V** |
| **200** | 250 | 50 | 1.5 | 235.9 | 320 | 825 | **NNCF4840V** |
| | 280 | 80 | 2.1 | 259.5 | 665 | 1 500 | **NNCF4940V** |
| | 310 | 150 | 2.1 | 287.75 | 1 560 | 3 000 | **NNCF5040V** |
| **220** | 270 | 50 | 1.5 | 256.9 | 340 | 905 | **NNCF4844V** |
| | 300 | 80 | 2.1 | 277 | 695 | 1 620 | **NNCF4944V** |
| | 340 | 160 | 3 | 312.3 | 1 890 | 3 650 | **NNCF5044V** |
| **240** | 300 | 60 | 2 | 282.6 | 495 | 1 340 | **NNCF4848V** |
| | 320 | 80 | 2.1 | 300 | 725 | 1 770 | **NNCF4948V** |
| | 360 | 160 | 3 | 335.25 | 1 990 | 4 000 | **NNCF5048V** |
| **260** | 320 | 60 | 2 | 303.6 | 515 | 1 450 | **NNCF4852V** |
| | 360 | 100 | 2.1 | 331.5 | 1 050 | 2 530 | **NNCF4952V** |
| | 400 | 190 | 4 | 376.1 | 2 690 | 5 200 | **NNCF5052V** |

**Remark** Full-complement cylindrical roller bearings are designed for specific applications, when using them, please contact NSK.



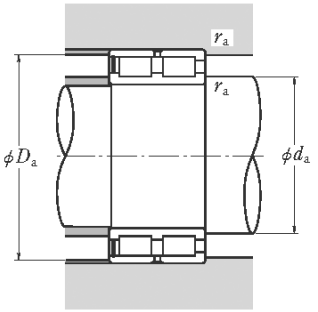

| Abutment and Fillet Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|
| $d_a$ min. | $D_a$ max. | $r_a$ max. | approx. |
| 109 | 130 | 1 | 2.0 |
| 111 | 140 | 1.5 | 3.8 |
| 119 | 140 | 1 | 2.1 |
| 122 | 157 | 2 | 6.1 |
| 130 | 155 | 1 | 2.9 |
| 132 | 168 | 2 | 6.5 |
| 141 | 168 | 1.5 | 3.9 |
| 142 | 187 | 2 | 10.3 |
| 151 | 178 | 1.5 | 4.2 |
| 152 | 198 | 2 | 10.8 |
| 163 | 196 | 2 | 6.6 |
| 165 | 209 | 2 | 13 |
| 173 | 206 | 2 | 7.0 |
| 175 | 225 | 2 | 15.8 |
| 183 | 216 | 2 | 7.3 |
| 185 | 244 | 2 | 22.1 |
| 193 | 236 | 2 | 10.7 |
| 195 | 263 | 2 | 29.4 |
| 203 | 245 | 2 | 11.1 |
| 206 | 273 | 2 | 30.8 |
| 213 | 237 | 1.5 | 5.9 |
| 216 | 263 | 2 | 15.7 |
| 216 | 293 | 2 | 39.7 |
| 233 | 257 | 1.5 | 6.4 |
| 236 | 283 | 2 | 17 |
| 238 | 320 | 2.5 | 50.7 |
| 254 | 285 | 2 | 10.3 |
| 257 | 302 | 2 | 18.4 |
| 259 | 340 | 2.5 | 54.3 |
| 275 | 304 | 2 | 11 |
| 277 | 342 | 2 | 32 |
| 282 | 377 | 2 | 82.7 |

## NNCF Type, Double-Row
## Bore Diameter 280 – 500 mm




| Boundary Dimensions (mm) | | | | | Basic Load Ratings (kN) | | Bearing Numbers |
|---|---|---|---|---|---|---|---|
| d | D | B | r min. | $E_W$ | $C_r$ | $C_{0r}$ | |
| **280** | 350 | 69 | 2 | 332.5 | 685 | 1 860 | **NNCF4856V** |
| | 380 | 100 | 2.1 | 352.5 | 1 090 | 2 720 | **NNCF4956V** |
| | 420 | 190 | 4 | 390.5 | 2 770 | 5 450 | **NNCF5056V** |
| **300** | 380 | 80 | 2.1 | 357.2 | 805 | 2 160 | **NNCF4860V** |
| | 420 | 118 | 3 | 386.5 | 1 580 | 3 800 | **NNCF4960V** |
| | 460 | 218 | 4 | 431.7 | 3 400 | 7 000 | **NNCF5060V** |
| **320** | 400 | 80 | 2.1 | 380.2 | 835 | 2 310 | **NNCF4864V** |
| | 440 | 118 | 3 | 404.5 | 1 620 | 4 000 | **NNCF4964V** |
| | 480 | 218 | 4 | 446.9 | 3 500 | 7 350 | **NNCF5064V** |
| **340** | 420 | 80 | 2.1 | 397.4 | 855 | 2 430 | **NNCF4868V** |
| | 460 | 118 | 3 | 431 | 1 690 | 4 300 | **NNCF4968V** |
| | 520 | 243 | 5 | 485.8 | 4 250 | 8 750 | **NNCF5068V** |
| **360** | 440 | 80 | 2.1 | 420.4 | 885 | 2 580 | **NNCF4872V** |
| | 480 | 118 | 3 | 449 | 1 730 | 4 500 | **NNCF4972V** |
| | 540 | 243 | 5 | 503.6 | 4 350 | 9 150 | **NNCF5072V** |
| **380** | 480 | 100 | 2.1 | 450.6 | 1 260 | 3 600 | **NNCF4876V** |
| | 520 | 140 | 4 | 482.5 | 2 180 | 5 650 | **NNCF4976V** |
| | 560 | 243 | 5 | 521.4 | 4 500 | 9 600 | **NNCF5076V** |
| **400** | 500 | 100 | 2.1 | 471.7 | 1 290 | 3 750 | **NNCF4880V** |
| | 540 | 140 | 4 | 503 | 2 240 | 5 900 | **NNCF4980V** |
| | 600 | 272 | 5 | 558.7 | 5 050 | 10 900 | **NNCF5080V** |
| **420** | 520 | 100 | 2.1 | 492 | 1 320 | 3 950 | **NNCF4884V** |
| | 560 | 140 | 4 | 523 | 2 290 | 6 200 | **NNCF4984V** |
| | 620 | 272 | 5 | 577.7 | 5 150 | 11 300 | **NNCF5084V** |
| **440** | 540 | 100 | 2.1 | 513 | 1 350 | 4 150 | **NNCF4888V** |
| | 600 | 160 | 4 | 560.5 | 3 000 | 7 850 | **NNCF4988V** |
| **460** | 580 | 118 | 3 | 549.2 | 1 730 | 5 150 | **NNCF4892V** |
| | 620 | 160 | 4 | 573 | 3 050 | 8 050 | **NNCF4992V** |
| **480** | 600 | 118 | 3 | 565.8 | 1 760 | 5 300 | **NNCF4896V** |
| | 650 | 170 | 5 | 603 | 3 350 | 8 900 | **NNCF4996V** |
| **500** | 620 | 118 | 3 | 590.7 | 1 810 | 5 600 | **NNCF48/500V** |
| | 670 | 170 | 5 | 629 | 3 400 | 9 350 | **NNCF49/500V** |

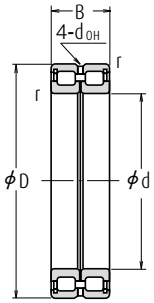
**Remark** Full-complement cylindrical roller bearings are designed for specific applications, when using them, please contact NSK.



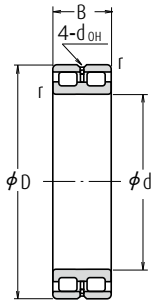

| Abutment and Fillet Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|
| $d_a$ min. | $D_a$ max. | $r_a$ max. | approx. |
| 295 | 334 | 2 | 16 |
| 297 | 361 | 2 | 34 |
| 302 | 395 | 3 | 87.7 |
| 318 | 361 | 2 | 23 |
| 320 | 398 | 2.5 | 52 |
| 323 | 435 | 3 | 125 |
| 338 | 381 | 2 | 24.3 |
| 340 | 418 | 2.5 | 55 |
| 343 | 454 | 3 | 131 |
| 359 | 400 | 2 | 25.6 |
| 361 | 438 | 2.5 | 58 |
| 368 | 490 | 4 | 177 |
| 379 | 421 | 2 | 27 |
| 381 | 457 | 2.5 | 61 |
| 388 | 509 | 4 | 186 |
| 399 | 459 | 2 | 45.5 |
| 404 | 493 | 3 | 90.5 |
| 408 | 529 | 4 | 194 |
| 420 | 479 | 2 | 47.5 |
| 425 | 513 | 3 | 94.5 |
| 429 | 568 | 4 | 256 |
| 440 | 498 | 2 | 49.5 |
| 445 | 533 | 3 | 98.5 |
| 449 | 588 | 4 | 267 |
| 461 | 518 | 2 | 51.5 |
| 466 | 572 | 3 | 136 |
| 483 | 555 | 2.5 | 77.5 |
| 486 | 591 | 3 | 142 |
| 503 | 575 | 2.5 | 80.5 |
| 510 | 617 | 4 | 167 |
| 524 | 594 | 2.5 | 83.5 |
| 531 | 637 | 4 | 173 |

# Full-Complement Cylindrical Roller Bearings for Sheaves

**RS-48 · RS-49 Types**
**RSF-48 · RSF-49 Types**
**Bore Diameter 50 – 220 mm**



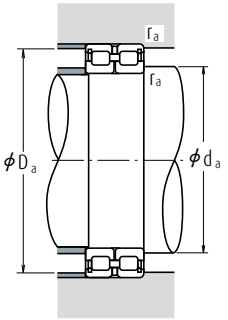
Fixed-End Bearing
RS



Free-End Bearing
RSF

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Limiting Speeds ($min^{-1}$) | |
|---|---|---|---|---|---|---|---|
| d | D | B | r min. | $C_r$ | $C_{0r}$ | Grease | Oil |
| **50** | 72 | 22 | 0.6 | 48 000 | 75 500 | 2 000 | 4 000 |
| **60** | 85 | 25 | 1 | 68 500 | 118 000 | 1 600 | 3 200 |
| **65** | 90 | 25 | 1 | 70 500 | 125 000 | 1 600 | 3 200 |
| **70** | 100 | 30 | 1 | 102 000 | 168 000 | 1 400 | 2 800 |
| **80** | 110 | 30 | 1 | 109 000 | 191 000 | 1 300 | 2 600 |
| **90** | 125 | 35 | 1.1 | 147 000 | 268 000 | 1 100 | 2 200 |
| **100** | 125 | 25 | 1 | 87 500 | 189 000 | 1 100 | 2 200 |
| | 140 | 40 | 1.1 | 194 000 | 400 000 | 1 000 | 2 000 |
| **105** | 130 | 25 | 1 | 89 000 | 196 000 | 1 000 | 2 000 |
| | 145 | 40 | 1.1 | 199 000 | 420 000 | 950 | 1 900 |
| **110** | 140 | 30 | 1 | 114 000 | 260 000 | 950 | 1 900 |
| | 150 | 40 | 1.1 | 202 000 | 430 000 | 900 | 1 800 |
| **120** | 150 | 30 | 1 | 119 000 | 283 000 | 900 | 1 800 |
| | 165 | 45 | 1.1 | 226 000 | 480 000 | 800 | 1 600 |
| **130** | 165 | 35 | 1.1 | 162 000 | 390 000 | 800 | 1 600 |
| | 180 | 50 | 1.5 | 262 000 | 555 000 | 750 | 1 500 |
| **140** | 175 | 35 | 1.1 | 167 000 | 415 000 | 710 | 1 400 |
| | 190 | 50 | 1.5 | 272 000 | 595 000 | 670 | 1 400 |
| **150** | 190 | 40 | 1.1 | 235 000 | 575 000 | 670 | 1 300 |
| | 210 | 60 | 2 | 390 000 | 865 000 | 630 | 1 300 |
| **160** | 200 | 40 | 1.1 | 243 000 | 615 000 | 600 | 1 200 |
| | 220 | 60 | 2 | 410 000 | 930 000 | 600 | 1 200 |
| **170** | 215 | 45 | 1.1 | 265 000 | 650 000 | 600 | 1 200 |
| | 230 | 60 | 2 | 415 000 | 975 000 | 600 | 1 200 |
| **180** | 225 | 45 | 1.1 | 272 000 | 685 000 | 560 | 1 100 |
| | 250 | 69 | 2 | 495 000 | 1 130 000 | 530 | 1 100 |
| **190** | 240 | 50 | 1.5 | 315 000 | 785 000 | 530 | 1 100 |
| | 260 | 69 | 2 | 510 000 | 1 180 000 | 500 | 1 000 |
| **200** | 250 | 50 | 1.5 | 320 000 | 825 000 | 500 | 1 000 |
| | 280 | 80 | 2.1 | 665 000 | 1 500 000 | 480 | 950 |
| **220** | 270 | 50 | 1.5 | 340 000 | 905 000 | 450 | 900 |
| | 300 | 80 | 2.1 | 695 000 | 1 620 000 | 430 | 850 |

**Remark** Cylindrical roller bearings for sheaves are designed for specific applications, when using them, please contact NSK.

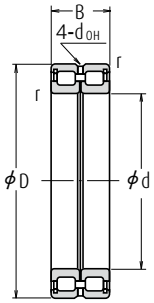



| Bearing Numbers (1) | | Dimensions (mm) | | Abutment and Fillet Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|---|---|---|---|
| Fixed-End Bearing | Free-End Bearing | $d_{OH}$(2) | Axial Disp.(3) | $d_a$ min. | $D_a$ max. | $r_a$ max. | approx. |
| RS-4910E4 | RSF-4910E4 | 2.5 | 1.5 | 54 | 68 | 0.6 | 0.30 |
| RS-4912E4 | RSF-4912E4 | 2.5 | 1.5 | 65 | 80 | 1 | 0.46 |
| RS-4913E4 | RSF-4913E4 | 2.5 | 2 | 70 | 85 | 1 | 0.50 |
| RS-4914E4 | RSF-4914E4 | 3 | 2 | 75 | 95 | 1 | 0.79 |
| RS-4916E4 | RSF-4916E4 | 3 | 2 | 85 | 105 | 1 | 0.89 |
| RS-4918E4 | RSF-4918E4 | 3 | 2 | 96.5 | 118.5 | 1 | 1.35 |
| RS-4820E4 | RSF-4820E4 | 2.5 | 1.5 | 105 | 120 | 1 | 0.74 |
| RS-4920E4 | RSF-4920E4 | 3 | 2 | 106.5 | 133.5 | 1 | 1.97 |
| RS-4821E4 | RSF-4821E4 | 2.5 | 1.5 | 110 | 125 | 1 | 0.77 |
| RS-4921E4 | RSF-4921E4 | 3 | 2 | 111.5 | 138.5 | 1 | 2.05 |
| RS-4822E4 | RSF-4822E4 | 3 | 2 | 115 | 135 | 1 | 1.09 |
| RS-4922E4 | RSF-4922E4 | 3 | 2 | 116.5 | 143.5 | 1 | 2.15 |
| RS-4824E4 | RSF-4824E4 | 3 | 2 | 125 | 145 | 1 | 1.28 |
| RS-4924E4 | RSF-4924E4 | 4 | 3 | 126.5 | 158.5 | 1 | 2.95 |
| RS-4826E4 | RSF-4826E4 | 3 | 2 | 136.5 | 158.5 | 1 | 1.9 |
| RS-4926E4 | RSF-4926E4 | 5 | 3.5 | 138 | 172 | 1.5 | 3.95 |
| RS-4828E4 | RSF-4828E4 | 3 | 2 | 146.5 | 168.5 | 1 | 2.03 |
| RS-4928E4 | RSF-4928E4 | 5 | 3.5 | 148 | 182 | 1.5 | 4.25 |
| RS-4830E4 | RSF-4830E4 | 3 | 2 | 156.5 | 183.5 | 1 | 2.85 |
| RS-4930E4 | RSF-4930E4 | 5 | 3.5 | 159 | 201 | 2 | 6.65 |
| RS-4832E4 | RSF-4832E4 | 3 | 2 | 166.5 | 193.5 | 1 | 3.05 |
| RS-4932E4 | RSF-4932E4 | 5 | 3.5 | 169 | 211 | 2 | 7.0 |
| RS-4834E4 | RSF-4834E4 | 4 | 3 | 176.5 | 208.5 | 1 | 4.1 |
| RS-4934E4 | RSF-4934E4 | 4 | 3.5 | 179 | 221 | 2 | 7.35 |
| RS-4836E4 | RSF-4836E4 | 4 | 3 | 186.5 | 218.5 | 1 | 4.3 |
| RS-4936E4 | RSF-4936E4 | 6 | 4.5 | 189 | 241 | 2 | 10.7 |
| RS-4838E4 | RSF-4838E4 | 5 | 3.5 | 198 | 232 | 1.5 | 5.65 |
| RS-4938E4 | RSF-4938E4 | 6 | 4.5 | 199 | 251 | 2 | 11.1 |
| RS-4840E4 | RSF-4840E4 | 5 | 3.5 | 208 | 242 | 1.5 | 5.95 |
| RS-4940E4 | RSF-4940E4 | 7 | 5 | 211 | 269 | 2 | 15.7 |
| RS-4844E4 | RSF-4844E4 | 5 | 3.5 | 228 | 262 | 1.5 | 6.45 |
| RS-4944E4 | RSF-4944E4 | 7 | 5 | 231 | 289 | 2 | 17 |

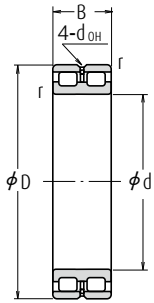
**Notes**
(1) The suffix E4 indicates that the outer ring is provided with oil holes and oil groove.
(2) $d_{OH}$ represents the oil hole diameter in the outer ring.
(3) Permissible axial displacement for free-end bearings.

# Full-Complement Cylindrical Roller Bearings for Sheaves

## RS-48 · RS-49 Types
## RSF-48 · RSF-49 Types
## Bore Diameter 240 – 560 mm



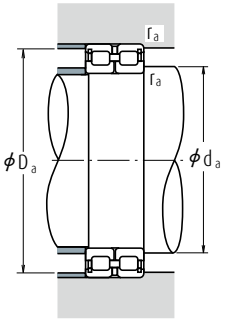
Fixed-End Bearing
RS



Free-End Bearing
RSF

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Limiting Speeds (min$^{-1}$) | |
|---|---|---|---|---|---|---|---|
| d | D | B | r min. | $C_r$ | $C_{0r}$ | Grease | Oil |
| **240** | 300 | 60 | 2 | 495 000 | 1 340 000 | 430 | 850 |
| | 320 | 80 | 2.1 | 725 000 | 1 770 000 | 400 | 800 |
| **260** | 320 | 60 | 2 | 515 000 | 1 450 000 | 380 | 750 |
| | 360 | 100 | 2.1 | 1 050 000 | 2 530 000 | 360 | 710 |
| **280** | 350 | 69 | 2 | 610 000 | 1 690 000 | 340 | 710 |
| | 380 | 100 | 2.1 | 1 090 000 | 2 720 000 | 340 | 670 |
| **300** | 380 | 80 | 2.1 | 805 000 | 2 160 000 | 320 | 630 |
| | 420 | 118 | 3 | 1 460 000 | 3 400 000 | 300 | 600 |
| **320** | 400 | 80 | 2.1 | 835 000 | 2 310 000 | 300 | 600 |
| | 440 | 118 | 3 | 1 500 000 | 3 600 000 | 280 | 560 |
| **340** | 420 | 80 | 2.1 | 855 000 | 2 430 000 | 280 | 560 |
| | 460 | 118 | 3 | 1 560 000 | 3 900 000 | 260 | 530 |
| **360** | 440 | 80 | 2.1 | 885 000 | 2 580 000 | 260 | 530 |
| | 480 | 118 | 3 | 1 600 000 | 4 050 000 | 260 | 500 |
| **380** | 480 | 100 | 2.1 | 1 260 000 | 3 600 000 | 240 | 500 |
| | 520 | 140 | 4 | 2 040 000 | 5 200 000 | 240 | 450 |
| **400** | 500 | 100 | 2.1 | 1 290 000 | 3 750 000 | 240 | 480 |
| | 540 | 140 | 4 | 2 100 000 | 5 450 000 | 220 | 450 |
| **420** | 520 | 100 | 2.1 | 1 320 000 | 3 950 000 | 220 | 450 |
| | 560 | 140 | 4 | 2 150 000 | 5 700 000 | 200 | 430 |
| **440** | 540 | 100 | 2.1 | 1 350 000 | 4 150 000 | 200 | 430 |
| | 600 | 160 | 4 | 2 840 000 | 7 350 000 | 190 | 380 |
| **460** | 580 | 118 | 3 | 1 730 000 | 5 150 000 | 190 | 380 |
| | 620 | 160 | 4 | 2 870 000 | 7 500 000 | 190 | 380 |
| **480** | 600 | 118 | 3 | 1 760 000 | 5 300 000 | 190 | 380 |
| | 650 | 170 | 5 | 3 200 000 | 8 500 000 | 180 | 360 |
| **500** | 620 | 118 | 3 | 1 810 000 | 5 600 000 | 180 | 360 |
| | 670 | 170 | 5 | 3 300 000 | 8 900 000 | 170 | 340 |
| **530** | 710 | 180 | 5 | 3 400 000 | 9 200 000 | 160 | 320 |
| **560** | 750 | 190 | 5 | 3 800 000 | 10 100 000 | 150 | 300 |

**Remark** Cylindrical roller bearings for sheaves are designed for specific applications, when using them, please contact NSK.



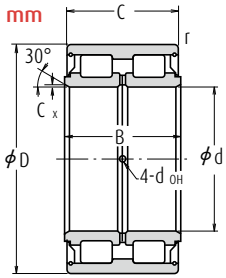

| Bearing Numbers (1) | | Dimensions (mm) | | Abutment and Fillet Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|---|---|---|---|
| Fixed-End Bearing | Free-End Bearing | $d_{OH}$(2) | Axial Disp.(3) | $d_a$ min. | $D_a$ max. | $r_a$ max. | approx. |
| RS-4848E4 | RSF-4848E4 | 5 | 3.5 | 249 | 291 | 2 | 10.3 |
| RS-4948E4 | RSF-4948E4 | 7 | 5 | 251 | 309 | 2 | 18.4 |
| RS-4852E4 | RSF-4852E4 | 5 | 3.5 | 269 | 311 | 2 | 11 |
| RS-4952E4 | RSF-4952E4 | 8 | 6 | 271 | 349 | 2 | 32 |
| RS-4856E4 | RSF-4856E4 | 6 | 4.5 | 289 | 341 | 2 | 16 |
| RS-4956E4 | RSF-4956E4 | 8 | 6 | 291 | 369 | 2 | 34 |
| RS-4860E4 | RSF-4860E4 | 6 | 5 | 311 | 369 | 2 | 23 |
| RS-4960E4 | RSF-4960E4 | 9 | 7 | 313 | 407 | 2.5 | 52 |
| RS-4864E4 | RSF-4864E4 | 6 | 5 | 331 | 389 | 2 | 24.3 |
| RS-4964E4 | RSF-4964E4 | 9 | 7 | 333 | 427 | 2.5 | 55 |
| RS-4868E4 | RSF-4868E4 | 6 | 5 | 351 | 409 | 2 | 25.6 |
| RS-4968E4 | RSF-4968E4 | 9 | 7 | 353 | 447 | 2.5 | 58 |
| RS-4872E4 | RSF-4872E4 | 6 | 5 | 371 | 429 | 2 | 27 |
| RS-4972E4 | RSF-4972E4 | 9 | 7 | 373 | 467 | 2.5 | 61 |
| RS-4876E4 | RSF-4876E4 | 8 | 6 | 391 | 469 | 2 | 45.5 |
| RS-4976E4 | RSF-4976E4 | 11 | 8 | 396 | 504 | 3 | 90.5 |
| RS-4880E4 | RSF-4880E4 | 8 | 6 | 411 | 489 | 2 | 47.5 |
| RS-4980E4 | RSF-4980E4 | 11 | 8 | 416 | 524 | 3 | 94.5 |
| RS-4884E4 | RSF-4884E4 | 8 | 6 | 431 | 509 | 2 | 49.5 |
| RS-4984E4 | RSF-4984E4 | 11 | 8 | 436 | 544 | 3 | 98.5 |
| RS-4888E4 | RSF-4888E4 | 8 | 6 | 451 | 529 | 2 | 51.5 |
| RS-4988E4 | RSF-4988E4 | 11 | 8 | 456 | 584 | 3 | 136 |
| RS-4892E4 | RSF-4892E4 | 9 | 7 | 473 | 567 | 2.5 | 77.5 |
| RS-4992E4 | RSF-4992E4 | 11 | 8 | 476 | 604 | 3 | 142 |
| RS-4896E4 | RSF-4896E4 | 9 | 7 | 493 | 587 | 2.5 | 80.5 |
| RS-4996E4 | RSF-4996E4 | 12 | 9 | 500 | 630 | 4 | 167 |
| RS-48/500E4 | RSF-48/500E4 | 9 | 7 | 513 | 607 | 2.5 | 83.5 |
| RS-49/500E4 | RSF-49/500E4 | 12 | 9 | 520 | 650 | 4 | 173 |
| RS-49/530E4 | RSF-49/530E4 | 12 | 11 | 550 | 690 | 4 | 206 |
| RS-49/560E4 | RSF-49/560E4 | 12 | 11 | 580 | 730 | 4 | 231 |

**Notes**
(1) The suffix E4 indicates that the outer ring is provided with oil holes and oil groove.
(2) $d_{OH}$ represents the oil hole diameter in the outer ring.
(3) Permissible axial displacement for free-end bearings.

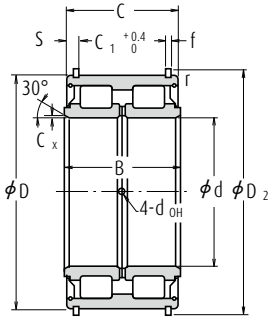
# Full-Complement Cylindrical Roller Bearings for Sheaves

## RS-50 Type (Prelubricated)

## Bore Diameter 40 – 400 mm




Without Locating Rings

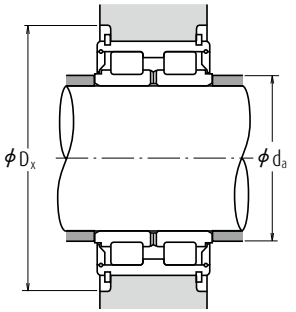



With Locating Rings

| Boundary Dimensions (mm) | | | | | | Basic Load Ratings (N) | | Limiting Speeds (min-1) |
|---|---|---|---|---|---|---|---|---|
| d | D | B | C | $C_x$(1) min. | r min. | $C_r$ | $C_{0r}$ | Grease |
| **40** | 68 | 38 | 37 | 0.4 | 0.6 | 79 500 | 116 000 | 2 400 |
| **45** | 75 | 40 | 39 | 0.4 | 0.6 | 95 500 | 144 000 | 2 200 |
| **50** | 80 | 40 | 39 | 0.4 | 0.6 | 100 000 | 158 000 | 2 000 |
| **55** | 90 | 46 | 45 | 0.6 | 0.6 | 118 000 | 193 000 | 1 800 |
| **60** | 95 | 46 | 45 | 0.6 | 0.6 | 123 000 | 208 000 | 1 700 |
| **65** | 100 | 46 | 45 | 0.6 | 0.6 | 128 000 | 224 000 | 1 600 |
| **70** | 110 | 54 | 53 | 0.6 | 0.6 | 171 000 | 285 000 | 1 400 |
| **75** | 115 | 54 | 53 | 0.6 | 0.6 | 179 000 | 305 000 | 1 400 |
| **80** | 125 | 60 | 59 | 0.6 | 0.6 | 251 000 | 430 000 | 1 200 |
| **85** | 130 | 60 | 59 | 0.6 | 0.6 | 256 000 | 445 000 | 1 200 |
| **90** | 140 | 67 | 66 | 1 | 0.6 | 305 000 | 540 000 | 1 100 |
| **95** | 145 | 67 | 66 | 1 | 0.6 | 310 000 | 565 000 | 1 100 |
| **100** | 150 | 67 | 66 | 1 | 0.6 | 320 000 | 585 000 | 1 000 |
| **110** | 170 | 80 | 79 | 1.1 | 1 | 385 000 | 695 000 | 900 |
| **120** | 180 | 80 | 79 | 1.1 | 1 | 400 000 | 750 000 | 850 |
| **130** | 200 | 95 | 94 | 1.1 | 1 | 535 000 | 1 000 000 | 750 |
| **140** | 210 | 95 | 94 | 1.1 | 1 | 550 000 | 1 040 000 | 710 |
| **150** | 225 | 100 | 99 | 1.3 | 1 | 620 000 | 1 210 000 | 670 |
| **160** | 240 | 109 | 108 | 1.3 | 1.1 | 695 000 | 1 370 000 | 630 |
| **170** | 260 | 122 | 121 | 1.3 | 1.1 | 860 000 | 1 680 000 | 600 |
| **180** | 280 | 136 | 135 | 1.3 | 1.1 | 980 000 | 1 910 000 | 530 |
| **190** | 290 | 136 | 135 | 1.3 | 1.1 | 1 120 000 | 2 230 000 | 500 |
| **200** | 310 | 150 | 149 | 1.3 | 1.1 | 1 310 000 | 2 650 000 | 480 |
| **220** | 340 | 160 | 159 | 1.5 | 1.1 | 1 510 000 | 3 100 000 | 430 |
| **240** | 360 | 160 | 159 | 1.5 | 1.1 | 1 570 000 | 3 350 000 | 400 |
| **260** | 400 | 190 | 189 | 1.5 | 1.5 | 2 130 000 | 4 500 000 | 360 |
| **280** | 420 | 190 | 189 | 1.5 | 1.5 | 2 170 000 | 4 700 000 | 340 |
| **300** | 460 | 218 | 216 | 1.5 | 1.5 | 2 670 000 | 5 850 000 | 300 |
| **320** | 480 | 218 | 216 | 1.5 | 1.5 | 2 720 000 | 6 100 000 | 300 |
| **340** | 520 | 243 | 241 | 2 | 2 | 3 350 000 | 7 550 000 | 260 |
| **360** | 540 | 243 | 241 | 2 | 2 | 3 450 000 | 7 850 000 | 260 |
| **380** | 560 | 243 | 241 | 2 | 2 | 3 550 000 | 8 400 000 | 240 |
| **400** | 600 | 272 | 270 | 2 | 2 | 4 250 000 | 9 950 000 | 220 |

**Note** (1) Chamfer dimension of inner ring in radial direction.

**Remarks**
1. Good quality grease is prepacked in bearings.
2. Grease can be supplied through oil holes in the inner rings.




| Bearing Numbers | | Locating Ring Dimensions (mm) | | | | Oil Holes (mm) | Abutment and Fillet Dimensions (mm) | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|
| Without Locating Rings | With Locating Rings | $C_1$ | S | $D_2$ | f | $d_{OH}$ | $d_a$ min. | $D_x$ min. | approx. |
| RS-5008 | RS-5008NR | 28 | 4.5 | 71.8 | 2 | 2.5 | 43.5 | 77.5 | 0.56 |
| RS-5009 | RS-5009NR | 30 | 4.5 | 78.8 | 2 | 2.5 | 48.5 | 84.5 | 0.70 |
| RS-5010 | RS-5010NR | 30 | 4.5 | 83.8 | 2 | 2.5 | 53.5 | 89.5 | 0.76 |
| RS-5011 | RS-5011NR | 34 | 5.5 | 94.8 | 2.5 | 3 | 60 | 101 | 1.17 |
| RS-5012 | RS-5012NR | 34 | 5.5 | 99.8 | 2.5 | 3 | 65 | 106 | 1.25 |
| RS-5013 | RS-5013NR | 34 | 5.5 | 104.8 | 2.5 | 3 | 70 | 111 | 1.32 |
| RS-5014 | RS-5014NR | 42 | 5.5 | 114.5 | 2.5 | 3 | 75 | 121 | 1.87 |
| RS-5015 | RS-5015NR | 42 | 5.5 | 119.5 | 2.5 | 3 | 80 | 126 | 2.0 |
| RS-5016 | RS-5016NR | 48 | 5.5 | 129.5 | 2.5 | 3 | 85 | 136 | 2.65 |
| RS-5017 | RS-5017NR | 48 | 5.5 | 134.5 | 2.5 | 3 | 90 | 141 | 2.75 |
| RS-5018 | RS-5018NR | 54 | 6 | 145.4 | 2.5 | 4 | 96 | 153.5 | 3.75 |
| RS-5019 | RS-5019NR | 54 | 6 | 150.4 | 2.5 | 4 | 101 | 158.5 | 3.95 |
| RS-5020 | RS-5020NR | 54 | 6 | 155.4 | 2.5 | 4 | 106 | 163.5 | 4.05 |
| RS-5022 | RS-5022NR | 65 | 7 | 175.4 | 2.5 | 5 | 116.5 | 183.5 | 6.1 |
| RS-5024 | RS-5024NR | 65 | 7 | 188 | 3 | 5 | 126.5 | 197 | 7.0 |
| RS-5026 | RS-5026NR | 77 | 8.5 | 207 | 3 | 5 | 136.5 | 217 | 10.6 |
| RS-5028 | RS-5028NR | 77 | 8.5 | 217 | 3 | 5 | 146.5 | 227 | 11.3 |
| RS-5030 | RS-5030NR | 81 | 9 | 232 | 3 | 6 | 157 | 242 | 13.7 |
| RS-5032 | RS-5032NR | 89 | 9.5 | 247 | 3 | 6 | 167 | 257 | 16.8 |
| RS-5034 | RS-5034NR | 99 | 11 | 270 | 4 | 6 | 177 | 285 | 22.2 |
| RS-5036 | RS-5036NR | 110 | 12.5 | 294 | 5 | 6 | 187 | 318 | 30 |
| RS-5038 | RS-5038NR | 110 | 12.5 | 304 | 5 | 6 | 197 | 328 | 32 |
| RS-5040 | RS-5040NR | 120 | 14.5 | 324 | 5 | 6 | 207 | 352 | 41 |
| RS-5044 | RS-5044NR | 130 | 14.5 | 356 | 6 | 7 | 228.5 | 382 | 53 |
| RS-5048 | RS-5048NR | 130 | 14.5 | 376 | 6 | 7 | 248.5 | 402 | 57 |
| RS-5052 | RS-5052NR | 154 | 17.5 | 416 | 7 | 8 | 270 | 444 | 86 |
| RS-5056 | RS-5056NR | 154 | 17.5 | 436 | 7 | 8 | 290 | 472 | 92 |
| RS-5060 | RS-5060NR | 178 | 19 | 476 | 7 | 8 | 310 | 512 | 130 |
| RS-5064 | — | — | — | — | — | 8 | 330 | — | 135 |
| RS-5068 | — | — | — | — | — | 10 | 352 | — | 185 |
| RS-5072 | — | — | — | — | — | 10 | 372 | — | 192 |
| RS-5076 | — | — | — | — | — | 10 | 392 | — | 196 |
| RS-5080 | — | — | — | — | — | 10 | 412 | — | 280 |

**Remarks**

3. Cylindrical roller bearings for sheaves are designed for specific applications, when using them, please contact NSK.
4. For shield with outside diameter larger than 180 mm, the above figure is different actual shape. For detail drawing, please contact NSK.


NSK

## 6. TAPERED ROLLER BEARINGS

Introduction ..... B 200

## TECHNICAL DATA

Free Space of Tapered Roller Bearings ..... B 206

## SINGLE-ROW TAPERED ROLLER BEARINGS


| Bore Dia. | Page |
|---|---|
| 15 – 100 mm | B 208 |
| 105 – 240 mm | B 220 |
| 260 – 440 mm | B 226 |


## INCH DESIGN TAPERED ROLLER BEARINGS

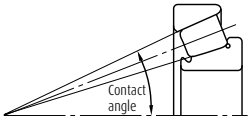

| Bore Dia. | Page |
|---|---|
| 12.000 – 47.625 mm | B 228 |
| 48.412 – 69.850 mm | B 242 |
| 70.000 – 206.375 mm | B 250 |


The index for inch design tapered roller bearings is in Appendix 14 (Page C020).

## DOUBLE-ROW TAPERED ROLLER BEARINGS


| Bore Dia. | Page |
|---|---|
| 40 – 260 mm | B 264 |

## DESIGN, TYPES AND FEATURES



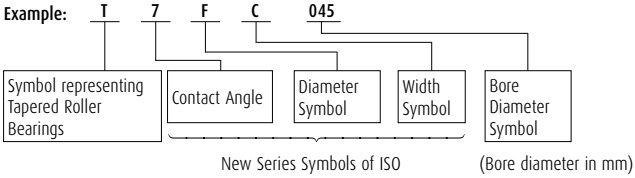

Tapered roller bearings are designed so the apices of the cones formed by the raceways of the cone and cup and the conical rollers all coincide at one point on the axis of the bearing. When a radial load is imposed, an axial force component occurs; therefore, it is necessary to use two bearings in opposition or some other multiple arrangement.

For metric-design medium-angle and steep-angle tapered roller bearings, the respective contact angle symbol C or D is added after the bore number. For normal-angle tapered roller bearings, no contact angle symbol is used.

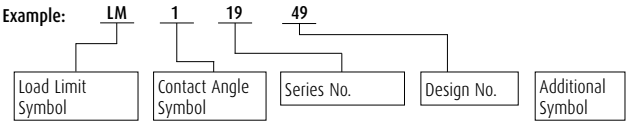
Medium-angle tapered roller bearings are primarily used for the pinion shafts of differential gears of automobiles.

Among those with high load capacity (HR series), some bearings have the basic number suffixed by J to conform to the specifications of ISO for the cup back face raceway diameter, cup width, and contact angle. Therefore, the cone assembly and cup of bearings with the same basic number suffixed by J are internationally interchangeable.

Among metric-design tapered roller bearings specified by ISO 355, there are those having new dimensions that are different from the dimension series 3XX used in the past. Part of them are listed in the bearing tables. They conform to the specifications of ISO for the smaller end diameter of the cup and contact angle. The cone and cup assemblies are internationally interchangeable. The bearing number formulation, which is different from that for past metric design, is as follows:



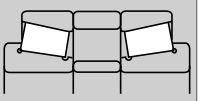
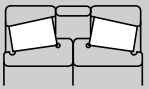
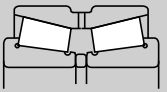
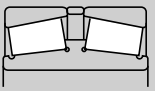
Besides metric design tapered roller bearings, there are also inch design bearings. For the cone assemblies and cups of inch design bearings, except four-row tapered roller bearings, the bearing numbers are approximately formulated as follows:




For tapered roller bearings, besides single-row bearings, there are also various combinations of bearings.

The cages of tapered roller bearings are usually pressed steel.

**Table 1 Design and Features of Combinations of Tapered Roller Bearings**

| Figure | Arrangement | Examples of Bearing No. | Features |
|---|---|---|---|
|  | Back-to-back | HR30210JDB+KLR10 | Two standard bearings are combined. The bearing clearance are adjusted by cone spacers or cup spacers. The cones and cups and spacers are marked with serial numbers and mating marks. Components with the same serial number can be assembled referring to the matching symbols. |
|  | Face-to-face | HR30210JDF+KR | |
|  | KBE Type | 100KBE31+L | The KBE type is a back-to-back arrangement of bearings with the cup and spacer integrated, and the KH type is a face-to-face arrangement in which the cones are integrated. Since the bearing clearance is adjusted using spacers, it is necessary for components to have the same serial number for assembly with reference to matching symbols. |
|  | KH Type | 110KH31+K | |

## TOLERANCES AND RUNNING ACCURACY


| | Tables | Pages |
|---|---|---|
| Metric Design Tapered Roller Bearings | 7.3 | A 132 to A 135 |
| Inch Design Tapered Roller Bearings | 7.4 | A 136 and A 137 |


Among inch design tapered roller bearings, there are those to which the following precision classes apply. For more details, please consult with NSK.

1. J line bearings (in the bearing tables, bearings preceded by ▲)

### Table 2 Tolerances of Cones (CLASS K)

Units : μm

| Nominal Bore Diameter d (mm) | | $\Delta_{dmp}$ | | $V_{dp}$ | $V_{dmp}$ | $K_{ia}$ |
|---|---|---|---|---|---|---|
| over | incl. | high | low | max. | max. | max. |
| 10 | 18 | 0 | −12 | 12 | 9 | 15 |
| 18 | 30 | 0 | −12 | 12 | 9 | 18 |
| 30 | 50 | 0 | −12 | 12 | 9 | 20 |
| 50 | 80 | 0 | −15 | 15 | 11 | 25 |
| 80 | 120 | 0 | −20 | 20 | 15 | 30 |
| 120 | 180 | 0 | −25 | 25 | 19 | 35 |
| 180 | 250 | 0 | −30 | 30 | 23 | 50 |
| 250 | 315 | 0 | −35 | 35 | 26 | 60 |
| 315 | 400 | 0 | −40 | 40 | 30 | 70 |

### Table 3 Tolerances of Cups (CLASS K)

Units : μm

| Nominal Outside Diameter D (mm) | | $\Delta_{Dmp}$ | | $V_{Dp}$ | $V_{Dmp}$ | $K_{ea}$ |
|---|---|---|---|---|---|---|
| over | incl. | high | low | max. | max. | max. |
| 18 | 30 | 0 | −12 | 12 | 9 | 18 |
| 30 | 50 | 0 | −14 | 14 | 11 | 20 |
| 50 | 80 | 0 | −16 | 16 | 12 | 25 |
| 80 | 120 | 0 | −18 | 18 | 14 | 35 |
| 120 | 150 | 0 | −20 | 20 | 15 | 40 |
| 150 | 180 | 0 | −25 | 25 | 19 | 45 |
| 180 | 250 | 0 | −30 | 30 | 23 | 50 |
| 250 | 315 | 0 | −35 | 35 | 26 | 60 |
| 315 | 400 | 0 | −40 | 40 | 30 | 70 |
| 400 | 500 | 0 | −45 | 45 | 34 | 80 |

**Table 4 Tolerances of Effective Widths of Cone Assemblies and Cups and Overall Width (CLASS K)** Units : μm

| Nominal Bore Diameter d (mm) | | Effective Width Deviation of Cone Assembly $\Delta_{T1s}$ | | Effective Width Deviation of Cup $\Delta_{T2s}$ | | Overall Width Deviation $\Delta_{Ts}$ | |
|---|---|---|---|---|---|---|---|
| over | incl. | high | low | high | low | high | low |
| 10 | 80 | +100 | 0 | +100 | 0 | +200 | 0 |
| 80 | 120 | +100 | −100 | +100 | −100 | +200 | −200 |
| 120 | 315 | +150 | −150 | +200 | −100 | +350 | −250 |
| 315 | 400 | +200 | −200 | +200 | −200 | +400 | −400 |

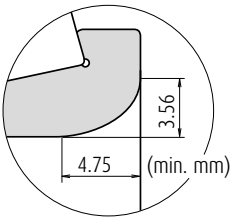
2. Bearings for Front Axles of Automobiles (In the bearing tables, those preceded by t)

**Table 5 Tolerances of Bore Diameter and Overall Width** Units : μm

| Nominal Bore Diameter d | | | Bore Diameter Deviation $\Delta_{ds}$ | | Overall Width Deviation $\Delta_{Ts}$ | |
|---|---|---|---|---|---|---|
| over (mm) | over 1/25.4 | incl. (mm) / incl. 1/25.4 | high | low | high | low |
| — | | 76.200 / 3.0000 | +20 | 0 | +356 | 0 |

The tolerances for outside diameter and those for radial runout of the cones and cups conform to Table 7.4.2 (Pages A136 and A137)

3. Special Chamfer Dimensions
For bearings marked "spec." in the column of r in the bearing tables, the chamfer dimension of the cone back-face side is as shown on the following figure.



## RECOMMENDED FITS


| | Table | Page |
|---|---|---|
| Metric Design Tapered Roller Bearings | 8.3 | A 164 |
| | 8.5 | A 165 |
| Inch Design Tapered Roller Bearings | 8.7 | A 166 |
| | 8.8 | A 167 |


## INTERNAL CLEARANCE


| | Table | Page |
|---|---|---|
| Metric Design Tapered Roller Bearings (Matched and Double-Row) | 8.17 | A 173 |
| Inch Design Tapered Roller Bearings (Matched and Double-Row) | 8.17 | A 173 |


## DIMENSIONS RELATED TO MOUNTING

The dimensions related to mounting tapered roller bearings are listed in the bearing tables. Since the cages protrude from the ring faces of tapered roller bearings, please use care when designing shafts and housings.

When heavy axial loads are imposed, the shaft shoulder dimensions and strength must be sufficient to support the cone rib.

## PERMISSIBLE MISALIGNMENT

The permissible misalignment angle for tapered roller bearings is approximately 0.0009 radian (3′).

## LIMITING SPEEDS (GREASE/OIL)

The limiting speeds for grease and oil lubrication listed in the bearing tables should be adjusted depending on the bearing load condition. Also, higher speeds are attainable by making changes in the lubrication method, cage design, etc. Refer to page A098 for detailed information.

## PRECAUTIONS FOR USE OF TAPERED ROLLER BEARINGS

1. If the load on tapered roller bearings becomes too small, or if the ratio of the axial and radial loads for matched bearings exceeds ‘e’(e is listed in the bearing tables) during operation, slippage between the rollers and raceways occurs, which may result in smearing. Especially with large bearings since the weight of the rollers and cage is high. If such load conditions are expected, please contact NSK for selection of the bearings.
2. Confirm the dimension of “Abutment and Fillet Dimensions” of $D_a$, $D_b$, $S_a$, $S_b$ at the time of the HR series adoption.

## TECHNICAL DATA

### Free Space of Tapered Roller Bearings

The tapered roller bearing can carry radial load and uni-direction axial loads. It offers high capacity. This type of bearing is used widely in machine systems with relatively severe loading conditions in various combinations by opposing or combining single-row bearings.

With a view towards easier maintenance and inspection, this kind of bearing is lubricated with grease in most cases. It is important to select a grease appropriate to the operating conditions and to use the proper amount of grease for the housing internal space. As a reference, the free space of a tapered roller bearing is shown in Table 6.

The free space of a tapered roller bearing is the space (shadowed portion) of the bearing outer volume less the inner and outer rings and cage, as shown in Fig. 1. The bearing is filled so that grease reaches the inner ring rib surface and pocket surface in sufficient amount.
Due attention must also be paid to the grease filling amount and state, especially if grease leakage occurs or maintenance of low running torque is important.

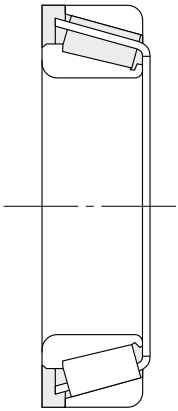


Fig. 1 Free Space of Tapered Roller Bearing

Table 6 Free Space of Tapered Roller Bearing

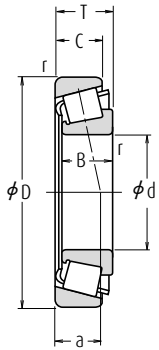
| Bearing bore No. | Bearing free space | |
|---|---|---|
| | Bearing series | |
| | HR329-J | HR320-XJ |
| 02 | — | — |
| 03 | — | — |
| 04 | — | 3.5 |
| /22 | — | 3.6 |
| 05 | — | 3.7 |
| /28 | — | 5.3 |
| 06 | — | 6.2 |
| /32 | — | 6.6 |
| 07 | 4.0 | 7.5 |
| 08 | 5.8 | 9.1 |
| 09 | — | 11 |
| 10 | — | 12 |
| 11 | 8.8 | 19 |
| 12 | 9.0 | 20 |
| 13 | — | 21 |
| 14 | 17 | 29 |
| 15 | — | 30 |
| 16 | — | 40 |
| 17 | — | 43 |
| 18 | 28 | 58 |
| 19 | 29 | 60 |
| 20 | 37 | 64 |

Units : $cm^3$

| Bearing free space | | | | | | | |
|---|---|---|---|---|---|---|---|
| Bearing series | | | | | | | |
| HR330-J | HR331-J | HR302-J | HR322-J | HR332-J | HR303-J | HR303-DJ | HR323-J |
| – | – | – | – | – | 4.5 | – | – |
| – | – | 3.3 | 4.3 | – | 5.7 | – | – |
| – | – | 5.3 | 6.6 | – | 7.2 | – | 9.2 |
| – | – | – | 7.3 | – | 9.1 | – | – |
| 4.3 | – | 6.3 | 7.4 | 7.5 | 11 | 13 | 15 |
| – | – | 8.8 | 9.8 | 10 | 16 | – | – |
| 6.7 | – | 9.2 | 11 | 12 | 18 | 21 | 23 |
| – | – | 11 | 13 | 14 | 20 | – | – |
| 8.9 | – | 13 | 17 | 18 | 23 | 26 | 35 |
| 11 | – | 18 | 23 | 25 | 31 | 35 | 45 |
| – | 18 | 22 | 24 | 26 | 41 | 48 | 58 |
| 15 | 20 | 23 | 26 | 29 | 55 | 59 | 77 |
| 21 | 29 | 30 | 36 | 40 | 72 | 78 | 99 |
| 23 | – | 39 | 47 | 53 | 88 | 95 | 130 |
| 25 | – | 45 | 62 | 65 | 110 | 120 | 150 |
| 33 | – | 53 | 67 | 69 | 130 | 150 | 190 |
| 34 | – | 58 | 73 | 74 | 160 | 180 | 230 |
| – | – | 75 | 91 | 100 | 200 | 200 | 270 |
| 49 | 76 | 92 | 120 | 130 | 230 | 250 | 320 |
| – | 110 | 110 | 150 | – | 260 | 310 | 370 |
| – | – | 140 | 170 | – | 310 | 350 | 430 |
| – | 150 | 160 | 210 | 240 | 380 | 460 | 580 |

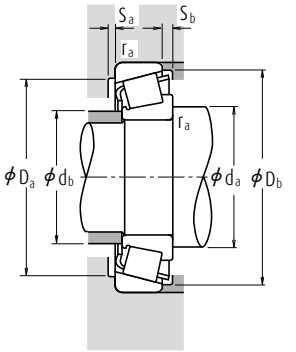
# Single-Row Tapered Roller Bearings

## Bore Diameter 15 – 28 mm




| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Limiting Speeds (min$^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cone | Cup | | | | |
| d | D | T | B | C | r min. | | $C_r$ | $C_{0r}$ | Grease | Oil |
| **15** | 35 | 11.75 | 11 | 10 | 0.6 | 0.6 | 14 800 | 13 200 | 11 000 | 15 000 |
| | 42 | 14.25 | 13 | 11 | 1 | 1 | 23 600 | 21 100 | 9 500 | 13 000 |
| **17** | 40 | 13.25 | 12 | 11 | 1 | 1 | 20 100 | 19 900 | 9 500 | 13 000 |
| | 40 | 17.25 | 16 | 14 | 1 | 1 | 27 100 | 28 000 | 9 500 | 13 000 |
| | 47 | 15.25 | 14 | 12 | 1 | 1 | 29 200 | 26 700 | 8 500 | 12 000 |
| | 47 | 15.25 | 14 | 10.5 | 1 | 1 | 22 000 | 20 300 | 8 000 | 11 000 |
| | 47 | 20.25 | 19 | 16 | 1 | 1 | 37 500 | 36 500 | 8 500 | 11 000 |
| **20** | 42 | 15 | 15 | 12 | 0.6 | 0.6 | 24 600 | 27 400 | 9 000 | 12 000 |
| | 47 | 15.25 | 14 | 12 | 1 | 1 | 27 900 | 28 500 | 8 000 | 11 000 |
| | 47 | 15.25 | 14 | 12 | 0.3 | 1 | 23 900 | 24 000 | 8 000 | 11 000 |
| | 47 | 19.25 | 18 | 15 | 1 | 1 | 35 500 | 37 500 | 8 500 | 11 000 |
| | 47 | 19.25 | 18 | 15 | 1 | 1 | 31 500 | 33 500 | 8 000 | 11 000 |
| | 52 | 16.25 | 15 | 13 | 1.5 | 1.5 | 35 000 | 33 500 | 7 500 | 10 000 |
| | 52 | 16.25 | 15 | 12 | 1.5 | 1.5 | 25 300 | 24 500 | 7 100 | 10 000 |
| | 52 | 22.25 | 21 | 18 | 1.5 | 1.5 | 45 500 | 47 500 | 8 000 | 11 000 |
| **22** | 44 | 15 | 15 | 11.5 | 0.6 | 0.6 | 25 600 | 29 400 | 8 500 | 11 000 |
| | 50 | 15.25 | 14 | 12 | 1 | 1 | 29 200 | 30 500 | 7 500 | 10 000 |
| | 50 | 15.25 | 14 | 12 | 1 | 1 | 27 200 | 29 500 | 7 500 | 10 000 |
| | 50 | 19.25 | 18 | 15 | 1 | 1 | 36 500 | 40 500 | 7 500 | 11 000 |
| | 50 | 19.25 | 18 | 15 | 1 | 1 | 33 500 | 39 500 | 7 500 | 10 000 |
| | 56 | 17.25 | 16 | 14 | 1.5 | 1.5 | 37 000 | 36 500 | 7 100 | 9 500 |
| | 56 | 17.25 | 16 | 13 | 1.5 | 1.5 | 34 500 | 34 000 | 6 700 | 9 500 |
| **25** | 47 | 15 | 15 | 11.5 | 0.6 | 0.6 | 27 400 | 33 000 | 8 000 | 11 000 |
| | 47 | 17 | 17 | 14 | 0.6 | 0.6 | 31 000 | 38 000 | 8 000 | 11 000 |
| | 52 | 16.25 | 15 | 13 | 1 | 1 | 32 000 | 35 000 | 7 100 | 10 000 |
| | 52 | 16.25 | 15 | 12 | 1 | 1 | 28 100 | 31 500 | 9 700 | 9 500 |
| | 52 | 19.25 | 18 | 16 | 1 | 1 | 40 000 | 45 000 | 7 100 | 10 000 |
| | 52 | 19.25 | 18 | 15 | 1 | 1 | 35 000 | 42 000 | 7 100 | 9 500 |
| | 52 | 22 | 22 | 18 | 1 | 1 | 47 500 | 56 500 | 7 500 | 10 000 |
| | 62 | 18.25 | 17 | 15 | 1.5 | 1.5 | 47 500 | 46 000 | 6 300 | 8 500 |
| | 62 | 18.25 | 17 | 14 | 1.5 | 1.5 | 42 000 | 45 000 | 6 000 | 8 500 |
| | 62 | 18.25 | 17 | 13 | 1.5 | 1.5 | 38 000 | 40 500 | 5 600 | 8 000 |
| | 62 | 18.25 | 17 | 13 | 1.5 | 1.5 | 38 000 | 40 500 | 5 600 | 8 000 |
| | 62 | 25.25 | 24 | 20 | 1.5 | 1.5 | 62 500 | 66 000 | 6 300 | 8 500 |
| **28** | 52 | 16 | 16 | 12 | 1 | 1 | 32 000 | 39 000 | 7 100 | 9 500 |
| | 58 | 17.25 | 16 | 14 | 1 | 1 | 39 500 | 41 500 | 6 300 | 9 000 |
| | 58 | 17.25 | 16 | 12 | 1 | 1 | 34 000 | 38 500 | 6 300 | 8 500 |
| | 58 | 20.25 | 19 | 16 | 1 | 1 | 47 500 | 54 000 | 6 300 | 9 000 |
| | 58 | 20.25 | 19 | 16 | 1 | 1 | 42 000 | 49 500 | 6 300 | 9 000 |
| | 68 | 19.75 | 18 | 15 | 1.5 | 1.5 | 55 000 | 55 500 | 6 000 | 8 000 |
| | 68 | 19.75 | 18 | 14 | 1.5 | 1.5 | 49 500 | 50 500 | 5 600 | 7 500 |

**Remark** The suffix C represents medium-angle tapered roller bearings. Since they are designed for specific applications, please consult NSK when using bearings with suffix C.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | 0 | 0.4 | $Y_1$ |

## Static Equivalent Load

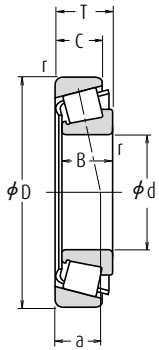
$P_0=0.5F_r+Y_0F_a$

When $F_r>0.5F_r+Y_0F_a$, use $P_0=F_r$

The values of e, $Y_1$ and $Y_0$ are given in the table below.

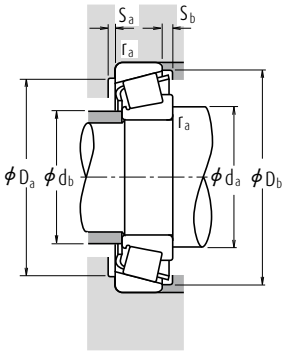
| Bearing Numbers | ISO355 Dimension Series | Abutment and Fillet Dimensions (mm) | | | | | | | | | Eff. Load Centers (mm) | Constant | Axial Load Factors | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Cone | Cup | | | | | |
| | approx. | $d_a$ min. | $d_b$ max. | $D_a$ max. | $D_a$ min. | $D_b$ min. | $S_a$ min. | $S_b$ min. | $r_a$ max. | | a | e | $Y_1$ | $Y_0$ | approx. |
| **30202** | — | 23 | 19 | 30 | 30 | 33 | 2 | 1.5 | 0.6 | 0.6 | 8.2 | 0.32 | 1.9 | 1.0 | 0.053 |
| **HR 30302 J** | 2FB | 24 | 22 | 36 | 36 | 38.5 | 2 | 3 | 1 | 1 | 9.5 | 0.29 | 2.1 | 1.2 | 0.098 |
| **HR 30203 J** | 2DB | 26 | 23 | 34 | 34 | 37.5 | 2 | 2 | 1 | 1 | 9.7 | 0.35 | 1.7 | 0.96 | 0.079 |
| **HR 32203 J** | 2DD | 26 | 22 | 34 | 34 | 37 | 2 | 3 | 1 | 1 | 11.2 | 0.31 | 1.9 | 1.1 | 0.103 |
| **HR 30303 J** | 2FB | 26 | 24 | 41 | 40 | 43 | 2 | 3 | 1 | 1 | 10.4 | 0.29 | 2.1 | 1.2 | 0.134 |
| **30303 D** | — | 29 | 23 | 41 | 34 | 44 | 2 | 4.5 | 1 | 1 | 15.4 | 0.81 | 0.74 | 0.41 | 0.129 |
| **HR 32303 J** | 2FD | 28 | 23 | 41 | 39 | 43 | 2 | 4 | 1 | 1 | 12.5 | 0.29 | 2.1 | 1.2 | 0.178 |
| **HR 32004 XJ** | 3CC | 28 | 24 | 37 | 35 | 40 | 3 | 3 | 0.6 | 0.6 | 10.6 | 0.37 | 1.6 | 0.88 | 0.097 |
| **HR 30204 J** | 2DB | 29 | 27 | 41 | 40 | 44 | 2 | 3 | 1 | 1 | 11.0 | 0.35 | 1.7 | 0.96 | 0.127 |
| **HR 30204 C-A-** | — | 29 | 26 | 41 | 37 | 44 | 2 | 3 | 0.3 | 1 | 13.0 | 0.55 | 1.1 | 0.60 | 0.126 |
| **HR 32204 J** | 2DD | 29 | 25 | 41 | 38 | 44.5 | 3 | 4 | 1 | 1 | 12.6 | 0.33 | 1.8 | 1.0 | 0.161 |
| **HR 32204 CJ** | 5DD | 29 | 25 | 41 | 36 | 44 | 2 | 4 | 1 | 1 | 14.5 | 0.52 | 1.2 | 0.64 | 0.166 |
| **HR 30304 J** | 2FB | 31 | 27 | 44 | 44 | 47.5 | 2 | 3 | 1.5 | 1.5 | 11.6 | 0.30 | 2.0 | 1.1 | 0.172 |
| **30304 D** | — | 34 | 26 | 43 | 37 | 49 | 2 | 4 | 1.5 | 1.5 | 16.7 | 0.81 | 0.74 | 0.41 | 0.168 |
| **HR 32304 J** | 2FD | 33 | 26 | 43 | 42 | 48 | 3 | 4 | 1.5 | 1.5 | 13.9 | 0.30 | 2.0 | 1.1 | 0.241 |
| **HR 320/22 XJ** | 3CC | 30 | 27 | 39 | 37 | 42 | 3 | 3.5 | 0.6 | 0.6 | 11.1 | 0.40 | 1.5 | 0.83 | 0.103 |
| **HR 302/22** | — | 31 | 29 | 44 | 42 | 47 | 2 | 3 | 1 | 1 | 11.6 | 0.37 | 1.6 | 0.90 | 0.139 |
| **HR 302/22 C** | — | 31 | 29 | 44 | 40 | 47 | 2 | 3 | 1 | 1 | 13.0 | 0.49 | 1.2 | 0.67 | 0.144 |
| **HR 322/22** | — | 31 | 28 | 44 | 41 | 47 | 2 | 4 | 1 | 1 | 13.5 | 0.37 | 1.6 | 0.89 | 0.18 |
| **HR 322/22 C** | — | 31 | 29 | 44 | 39 | 48 | 2 | 4 | 1 | 1 | 15.2 | 0.51 | 1.2 | 0.65 | 0.185 |
| **HR 303/22** | — | 33 | 30 | 47 | 46 | 50 | 2 | 3 | 1.5 | 1.5 | 12.4 | 0.32 | 1.9 | 1.0 | 0.208 |
| **HR 303/22 C** | — | 33 | 30 | 47 | 44 | 52.5 | 3 | 4 | 1.5 | 1.5 | 15.9 | 0.59 | 1.0 | 0.56 | 0.207 |
| **HR 32005 XJ** | 4CC | 33 | 30 | 42 | 40 | 45 | 3 | 3.5 | 0.6 | 0.6 | 11.8 | 0.43 | 1.4 | 0.77 | 0.116 |
| **HR 33005 J** | 2CE | 33 | 29 | 42 | 41 | 44 | 3 | 3 | 0.6 | 0.6 | 11.0 | 0.29 | 2.1 | 1.1 | 0.131 |
| **HR 30205 J** | 3CC | 34 | 31 | 46 | 44 | 48.5 | 2 | 3 | 1 | 1 | 12.7 | 0.37 | 1.6 | 0.88 | 0.157 |
| **HR 30205 C** | — | 34 | 32 | 46 | 43 | 49.5 | 2 | 4 | 1 | 1 | 14.4 | 0.53 | 1.1 | 0.62 | 0.155 |
| **HR 32205 J** | 2CD | 34 | 30 | 46 | 44 | 50 | 2 | 3 | 1 | 1 | 13.5 | 0.36 | 1.7 | 0.92 | 0.189 |
| **HR 32205 C** | — | 34 | 30 | 46 | 40 | 50 | 2 | 4 | 1 | 1 | 15.8 | 0.53 | 1.1 | 0.62 | 0.19 |
| **HR 33205 J** | 2DE | 34 | 29 | 46 | 43 | 49.5 | 4 | 4 | 1 | 1 | 14.1 | 0.35 | 1.7 | 0.94 | 0.221 |
| **HR 30305 J** | 2FB | 36 | 34 | 54 | 54 | 57 | 2 | 3 | 1.5 | 1.5 | 13.2 | 0.30 | 2.0 | 1.1 | 0.27 |
| **HR 30305 C** | — | 36 | 35 | 53 | 49 | 58.5 | 3 | 4 | 1.5 | 1.5 | 16.4 | 0.55 | 1.1 | 0.60 | 0.276 |
| **HR 30305 DJ** | (7FB) | 39 | 34 | 53 | 47 | 59 | 2 | 5 | 1.5 | 1.5 | 19.9 | 0.83 | 0.73 | 0.40 | 0.265 |
| **HR 31305 J** | 7FB | 39 | 33 | 53 | 47 | 59 | 3 | 5 | 1.5 | 1.5 | 19.9 | 0.83 | 0.73 | 0.40 | 0.265 |
| **HR 32305 J** | 2FD | 38 | 32 | 53 | 51 | 57 | 3 | 5 | 1.5 | 1.5 | 15.6 | 0.30 | 2.0 | 1.1 | 0.376 |
| **HR 320/28 XJ** | 4CC | 37 | 33 | 46 | 44 | 50 | 3 | 4 | 1 | 1 | 12.8 | 0.43 | 1.4 | 0.77 | 0.146 |
| **HR 302/28** | — | 37 | 34 | 52 | 50 | 55 | 2 | 3 | 1 | 1 | 13.2 | 0.35 | 1.7 | 0.93 | 0.203 |
| **HR 302/28 C** | — | 37 | 34 | 52 | 48 | 54 | 2 | 5 | 1 | 1 | 16.9 | 0.64 | 0.94 | 0.52 | 0.198 |
| **HR 322/28** | — | 37 | 34 | 52 | 49 | 55 | 2 | 4 | 1 | 1 | 14.6 | 0.37 | 1.6 | 0.89 | 0.243 |
| **HR 322/28 CJ** | 5DD | 37 | 33 | 52 | 45 | 55 | 2 | 4 | 1 | 1 | 16.8 | 0.56 | 1.1 | 0.59 | 0.251 |
| **HR 303/28** | — | 39 | 37 | 59 | 58 | 61 | 2 | 4.5 | 1.5 | 1.5 | 14.5 | 0.31 | 1.9 | 1.1 | 0.341 |
| **HR 303/28 C** | — | 39 | 38 | 59 | 57 | 63 | 3 | 5.5 | 1.5 | 1.5 | 17.4 | 0.52 | 1.2 | 0.64 | 0.335 |

## Bore Diameter 30 – 35 mm




| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Limiting Speeds (min$^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cone | Cup | | | | |
| d | D | T | B | C | r min. | | $C_r$ | $C_{0r}$ | Grease | Oil |
| **30** | 47 | 12 | 12 | 9 | 0.3 | 0.3 | 17 600 | 24 400 | 7 500 | 10 000 |
| | 55 | 17 | 17 | 13 | 1 | 1 | 36 000 | 44 500 | 6 700 | 9 000 |
| | 55 | 20 | 20 | 16 | 1 | 1 | 42 000 | 54 000 | 6 700 | 9 000 |
| | 62 | 17.25 | 16 | 14 | 1 | 1 | 43 000 | 47 500 | 6 000 | 8 000 |
| | 62 | 17.25 | 16 | 12 | 1 | 1 | 35 500 | 37 000 | 5 600 | 7 500 |
| | 62 | 21.25 | 20 | 17 | 1 | 1 | 52 000 | 60 000 | 6 000 | 8 500 |
| | 62 | 21.25 | 20 | 16 | 1 | 1 | 48 000 | 56 000 | 6 000 | 8 000 |
| | 62 | 25 | 25 | 19.5 | 1 | 1 | 66 500 | 79 500 | 6 000 | 8 000 |
| | 72 | 20.75 | 19 | 16 | 1.5 | 1.5 | 59 500 | 60 000 | 5 300 | 7 500 |
| | 72 | 20.75 | 19 | 14 | 1.5 | 1.5 | 56 500 | 55 500 | 5 300 | 7 100 |
| | 72 | 20.75 | 19 | 14 | 1.5 | 1.5 | 49 000 | 52 500 | 4 800 | 6 700 |
| | 72 | 20.75 | 19 | 14 | 1.5 | 1.5 | 49 000 | 52 500 | 4 800 | 6 800 |
| | 72 | 28.75 | 27 | 23 | 1.5 | 1.5 | 80 000 | 88 500 | 5 600 | 7 500 |
| | 72 | 28.75 | 27 | 23 | 1.5 | 1.5 | 76 000 | 86 500 | 5 600 | 7 500 |
| **32** | 58 | 17 | 17 | 13 | 1 | 1 | 37 500 | 47 000 | 6 300 | 8 500 |
| | 58 | 21 | 20 | 16 | 1 | 1 | 41 000 | 50 000 | 6 300 | 8 500 |
| | 65 | 18.25 | 17 | 15 | 1 | 1 | 48 500 | 54 000 | 5 600 | 8 000 |
| | 65 | 18.25 | 17 | 14 | 1 | 1 | 45 500 | 52 500 | 5 600 | 7 500 |
| | 65 | 22.25 | 21 | 18 | 1 | 1 | 56 000 | 65 000 | 6 000 | 8 000 |
| | 65 | 22.25 | 21 | 17 | 1 | 1 | 49 500 | 60 000 | 5 600 | 7 500 |
| | 65 | 26 | 26 | 20.5 | 1 | 1 | 70 000 | 86 500 | 5 600 | 8 000 |
| | 75 | 21.75 | 20 | 17 | 1.5 | 1.5 | 56 000 | 56 000 | 5 300 | 7 100 |
| **35** | 55 | 14 | 14 | 11.5 | 0.6 | 0.6 | 27 400 | 39 000 | 6 300 | 8 500 |
| | 62 | 18 | 18 | 14 | 1 | 1 | 43 500 | 55 500 | 5 600 | 8 000 |
| | 62 | 21 | 21 | 17 | 1 | 1 | 49 000 | 65 000 | 5 600 | 8 000 |
| | 72 | 18.25 | 17 | 15 | 1.5 | 1.5 | 54 000 | 59 500 | 5 300 | 7 100 |
| | 72 | 18.25 | 17 | 13 | 1.5 | 1.5 | 47 000 | 54 500 | 5 000 | 6 700 |
| | 72 | 24.25 | 23 | 19 | 1.5 | 1.5 | 70 500 | 83 500 | 5 300 | 7 100 |
| | 72 | 24.25 | 23 | 18 | 1.5 | 1.5 | 60 500 | 71 500 | 5 000 | 7 100 |
| | 72 | 28 | 28 | 22 | 1.5 | 1.5 | 86 500 | 108 000 | 5 300 | 7 100 |
| | 80 | 22.75 | 21 | 18 | 2 | 1.5 | 76 000 | 79 000 | 4 800 | 6 700 |
| | 80 | 22.75 | 21 | 16 | 2 | 1.5 | 68 000 | 70 500 | 4 800 | 6 300 |
| | 80 | 22.75 | 21 | 15 | 2 | 1.5 | 62 000 | 68 000 | 4 300 | 6 000 |
| | 80 | 22.75 | 21 | 15 | 2 | 1.5 | 62 000 | 68 000 | 4 300 | 6 000 |
| | 80 | 32.75 | 31 | 25 | 2 | 1.5 | 99 000 | 111 000 | 5 000 | 6 700 |

**Remark** The suffix C represents medium-angle tapered roller bearings. Since they are designed for specific applications, please consult NSK when using bearings with suffix C.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | 0 | 0.4 | $Y_1$ |

## Static Equivalent Load

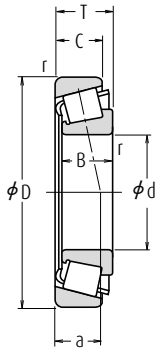
$P_0=0.5F_r+Y_0F_a$

When $F_r>0.5F_r+Y_0F_a$, use $P_0=F_r$

The values of e, $Y_1$ and $Y_0$ are given in the table below.

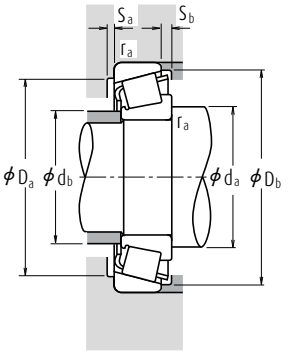
| Bearing Numbers | ISO355 Dimension Series | Abutment and Fillet Dimensions (mm) | | | | | | | | | Eff. Load Centers (mm) | Constant | Axial Load Factors | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Cone | Cup | | | | | |
| | | $d_a$ | $d_b$ | $D_a$ | | $D_b$ | $S_a$ | $S_b$ | $r_a$ | | | | | | |
| | approx. | min. | max. | max. | min. | min. | min. | min. | max. | | a | e | $Y_1$ | $Y_0$ | approx. |
| **HR 32906 J** | 2BD | 34 | 34 | 44 | 42 | 44 | 3 | 3 | 0.3 | 0.3 | 9.2 | 0.32 | 1.9 | 1.0 | 0.074 |
| **HR 32006 XJ** | 4CC | 39 | 35 | 49 | 47 | 53 | 3 | 4 | 1 | 1 | 13.5 | 0.43 | 1.4 | 0.77 | 0.172 |
| **HR 33006 J** | 2CE | 39 | 35 | 49 | 48 | 52 | 3 | 4 | 1 | 1 | 13.1 | 0.29 | 2.1 | 1.1 | 0.208 |
| **HR 30206 J** | 3DB | 39 | 37 | 56 | 52 | 58 | 2 | 3 | 1 | 1 | 13.9 | 0.37 | 1.6 | 0.88 | 0.238 |
| **HR 30206 C** | — | 39 | 36 | 56 | 49 | 59 | 2 | 5 | 1 | 1 | 17.8 | 0.68 | 0.88 | 0.49 | 0.221 |
| **HR 32206 J** | 3DC | 39 | 36 | 56 | 51 | 58.5 | 2 | 4 | 1 | 1 | 15.4 | 0.37 | 1.6 | 0.88 | 0.297 |
| **HR 32206 C** | — | 39 | 35 | 56 | 48 | 59 | 2 | 5 | 1 | 1 | 17.8 | 0.55 | 1.1 | 0.60 | 0.293 |
| **HR 33206 J** | 2DE | 39 | 35 | 56 | 52 | 59.5 | 5 | 5.5 | 1 | 1 | 16.1 | 0.34 | 1.8 | 0.97 | 0.355 |
| **HR 30306 J** | 2FB | 41 | 40 | 63 | 62 | 66 | 3 | 4.5 | 1.5 | 1.5 | 15.1 | 0.32 | 1.9 | 1.1 | 0.403 |
| **HR 30306 C** | — | 41 | 38 | 63 | 59 | 67 | 3 | 6.5 | 1.5 | 1.5 | 18.5 | 0.55 | 1.1 | 0.60 | 0.383 |
| **HR 30306 DJ** | (7FB) | 44 | 40 | 63 | 55 | 68 | 3 | 6.5 | 1.5 | 1.5 | 23.1 | 0.83 | 0.73 | 0.40 | 0.393 |
| **HR 31306 J** | 7FB | 44 | 40 | 63 | 55 | 68 | 3 | 6.5 | 1.5 | 1.5 | 23.1 | 0.83 | 0.73 | 0.40 | 0.393 |
| **HR 32306 J** | 2FD | 43 | 38 | 63 | 59 | 66 | 3 | 5.5 | 1.5 | 1.5 | 18.0 | 0.32 | 1.9 | 1.1 | 0.57 |
| **HR 32306 CJ** | 5FD | 43 | 36 | 63 | 54 | 68 | 3 | 5.5 | 1.5 | 1.5 | 22.0 | 0.55 | 1.1 | 0.60 | 0.583 |
| **HR 320/32 XJ** | 4CC | 41 | 37 | 52 | 49 | 55 | 3 | 4 | 1 | 1 | 14.2 | 0.45 | 1.3 | 0.73 | 0.191 |
| **330/32** | — | 41 | 37 | 52 | 50 | 55 | 2 | 4 | 1 | 1 | 13.8 | 0.31 | 1.9 | 1.1 | 0.225 |
| **HR 302/32** | — | 41 | 39 | 59 | 56 | 61 | 3 | 3 | 1 | 1 | 14.7 | 0.37 | 1.6 | 0.88 | 0.277 |
| **HR 302/32 C** | — | 41 | 39 | 59 | 54 | 62 | 3 | 4 | 1 | 1 | 16.9 | 0.55 | 1.1 | 0.60 | 0.273 |
| **HR 322/32** | — | 41 | 38 | 59 | 54 | 61 | 3 | 4 | 1 | 1 | 15.9 | 0.37 | 1.6 | 0.88 | 0.336 |
| **HR 322/32 C** | — | 41 | 39 | 59 | 51 | 62 | 3 | 5 | 1 | 1 | 20.2 | 0.59 | 1.0 | 0.56 | 0.335 |
| **HR 332/32 J** | 2DE | 41 | 38 | 59 | 55 | 62 | 5 | 5.5 | 1 | 1 | 17.0 | 0.35 | 1.7 | 0.95 | 0.40 |
| **303/32** | — | 44 | 42 | 66 | 64 | 68 | 3 | 4.5 | 1.5 | 1.5 | 15.9 | 0.33 | 1.8 | 1.0 | 0.435 |
| **HR 32907 J** | 2BD | 43 | 40 | 50 | 50 | 52.5 | 3 | 2.5 | 0.6 | 0.6 | 10.7 | 0.29 | 2.1 | 1.1 | 0.123 |
| **HR 32007 XJ** | 4CC | 44 | 40 | 56 | 54 | 60 | 4 | 4 | 1 | 1 | 15.0 | 0.45 | 1.3 | 0.73 | 0.229 |
| **HR 33007 J** | 2CE | 44 | 40 | 56 | 55 | 59 | 4 | 4 | 1 | 1 | 14.1 | 0.31 | 2.0 | 1.1 | 0.267 |
| **HR 30207 J** | 3DB | 46 | 43 | 63 | 62 | 67 | 3 | 3 | 1.5 | 1.5 | 15.0 | 0.37 | 1.6 | 0.88 | 0.34 |
| **HR 30207 C** | — | 46 | 44 | 63 | 59 | 68 | 3 | 5 | 1.5 | 1.5 | 19.6 | 0.66 | 0.91 | 0.50 | 0.331 |
| **HR 32207 J** | 3DC | 46 | 42 | 63 | 61 | 67.5 | 3 | 5 | 1.5 | 1.5 | 17.9 | 0.37 | 1.6 | 0.88 | 0.456 |
| **HR 32207 C** | — | 46 | 42 | 63 | 58 | 68.5 | 3 | 6 | 1.5 | 1.5 | 20.6 | 0.55 | 1.1 | 0.60 | 0.442 |
| **HR 33207 J** | 2DE | 46 | 41 | 63 | 61 | 68 | 5 | 6 | 1.5 | 1.5 | 18.3 | 0.35 | 1.7 | 0.93 | 0.54 |
| **HR 30307 J** | 2FB | 47 | 45 | 71 | 69 | 74 | 3 | 4.5 | 2 | 1.5 | 16.7 | 0.32 | 1.9 | 1.1 | 0.538 |
| **HR 30307 C** | — | 47 | 44 | 71 | 65 | 74 | 3 | 6.5 | 2 | 1.5 | 20.3 | 0.55 | 1.1 | 0.60 | 0.518 |
| **HR 30307 DJ** | 7FB | 51 | 44 | 71 | 62 | 77 | 3 | 7.5 | 2 | 1.5 | 25.2 | 0.83 | 0.73 | 0.40 | 0.519 |
| **HR 31307 J** | 7FB | 51 | 44 | 71 | 62 | 77 | 3 | 7.5 | 2 | 1.5 | 25.2 | 0.83 | 0.73 | 0.40 | 0.52 |
| **HR 32307 J** | 2FE | 49 | 43 | 71 | 66 | 74 | 3 | 7.5 | 2 | 1.5 | 20.7 | 0.32 | 1.9 | 1.1 | 0.765 |

## Bore Diameter 40 – 50 mm




| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Limiting Speeds (min$^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cone | Cup | | | | |
| d | D | T | B | C | r min. | | $C_r$ | $C_{0r}$ | Grease | Oil |
| **40** | 62 | 15 | 15 | 12 | 0.6 | 0.6 | 34 000 | 47 000 | 5 600 | 7 500 |
| | 68 | 19 | 19 | 14.5 | 1 | 1 | 53 000 | 71 000 | 5 300 | 7 100 |
| | 68 | 22 | 22 | 18 | 1 | 1 | 59 000 | 81 500 | 5 300 | 7 100 |
| | 75 | 26 | 26 | 20.5 | 1.5 | 1.5 | 78 500 | 101 000 | 4 800 | 6 700 |
| | 80 | 19.75 | 18 | 16 | 1.5 | 1.5 | 63 500 | 70 000 | 4 800 | 6 300 |
| | 80 | 24.75 | 23 | 19 | 1.5 | 1.5 | 77 000 | 90 500 | 4 800 | 6 300 |
| | 80 | 24.75 | 23 | 19 | 1.5 | 1.5 | 74 000 | 90 500 | 4 500 | 6 300 |
| | 80 | 32 | 32 | 25 | 1.5 | 1.5 | 107 000 | 137 000 | 4 800 | 6 300 |
| | 90 | 25.25 | 23 | 20 | 2 | 1.5 | 90 500 | 101 000 | 4 300 | 5 600 |
| | 90 | 25.25 | 23 | 18 | 2 | 1.5 | 84 500 | 93 500 | 4 300 | 5 600 |
| | 90 | 25.25 | 23 | 17 | 2 | 1.5 | 80 000 | 89 500 | 3 800 | 5 300 |
| | 90 | 25.25 | 23 | 17 | 2 | 1.5 | 80 000 | 89 500 | 3 800 | 5 300 |
| | 90 | 35.25 | 33 | 27 | 2 | 1.5 | 120 000 | 145 000 | 4 300 | 6 000 |
| **45** | 68 | 15 | 15 | 12 | 0.6 | 0.6 | 34 500 | 50 500 | 5 000 | 6 700 |
| | 75 | 20 | 20 | 15.5 | 1 | 1 | 60 000 | 83 000 | 4 500 | 6 300 |
| | 75 | 24 | 24 | 19 | 1 | 1 | 69 000 | 99 000 | 4 800 | 6 300 |
| | 80 | 26 | 26 | 20.5 | 1.5 | 1.5 | 84 000 | 113 000 | 4 500 | 6 000 |
| | 85 | 20.75 | 19 | 16 | 1.5 | 1.5 | 68 500 | 79 500 | 4 300 | 6 000 |
| | 85 | 24.75 | 23 | 19 | 1.5 | 1.5 | 83 000 | 102 000 | 4 300 | 6 000 |
| | 85 | 24.75 | 23 | 19 | 1.5 | 1.5 | 75 500 | 95 500 | 4 300 | 5 600 |
| | 85 | 32 | 32 | 25 | 1.5 | 1.5 | 111 000 | 147 000 | 4 300 | 6 000 |
| | 95 | 29 | 26.5 | 20 | 2.5 | 2.5 | 88 500 | 109 000 | 3 600 | 5 000 |
| | 95 | 36 | 35 | 30 | 2.5 | 2.5 | 139 000 | 174 000 | 4 000 | 5 300 |
| | 100 | 27.25 | 25 | 22 | 2 | 1.5 | 112 000 | 127 000 | 3 800 | 5 300 |
| | 100 | 27.25 | 25 | 18 | 2 | 1.5 | 95 500 | 109 000 | 3 400 | 4 800 |
| | 100 | 27.25 | 25 | 18 | 2 | 1.5 | 95 500 | 109 000 | 3 400 | 4 800 |
| | 100 | 38.25 | 36 | 30 | 2 | 1.5 | 144 000 | 177 000 | 3 800 | 5 300 |
| **50** | 100 | 36 | 35 | 30 | 2.5 | 2.5 | 144 000 | 185 000 | 3 800 | 5 000 |
| | 72 | 15 | 15 | 12 | 0.6 | 0.6 | 36 000 | 54 000 | 4 500 | 6 300 |
| | 80 | 20 | 20 | 15.5 | 1 | 1 | 61 000 | 87 000 | 4 300 | 6 000 |
| | 80 | 24 | 24 | 19 | 1 | 1 | 70 500 | 104 000 | 4 300 | 6 000 |
| | 85 | 26 | 26 | 20 | 1.5 | 1.5 | 89 000 | 126 000 | 4 300 | 5 600 |
| | 90 | 21.75 | 20 | 17 | 1.5 | 1.5 | 76 000 | 91 500 | 4 000 | 5 300 |
| | 90 | 24.75 | 23 | 19 | 1.5 | 1.5 | 87 500 | 109 000 | 4 000 | 5 300 |
| | 90 | 24.75 | 23 | 18 | 1.5 | 1.5 | 77 500 | 102 000 | 3 800 | 5 300 |
| | 90 | 32 | 32 | 24.5 | 1.5 | 1.5 | 118 000 | 165 000 | 4 000 | 5 300 |
| | 105 | 32 | 29 | 22 | 3 | 3 | 109 000 | 133 000 | 3 200 | 4 500 |
| | 110 | 29.25 | 27 | 23 | 2.5 | 2 | 130 000 | 148 000 | 3 400 | 4 800 |
| | 110 | 29.25 | 27 | 19 | 2.5 | 2 | 114 000 | 132 000 | 3 200 | 4 300 |
| | 110 | 29.25 | 27 | 19 | 2.5 | 2 | 114 000 | 132 000 | 3 200 | 4 300 |
| | 110 | 42.25 | 40 | 33 | 2.5 | 2 | 176 000 | 220 000 | 3 600 | 4 800 |
| | 110 | 42.25 | 40 | 33 | 2.5 | 2 | 164 000 | 218 000 | 3 400 | 4 800 |

**Remark** The suffix C represents medium-angle tapered roller bearings. Since they are designed for specific applications, please consult NSK when using bearings with suffix C.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | 0 | 0.4 | $Y_1$ |

## Static Equivalent Load

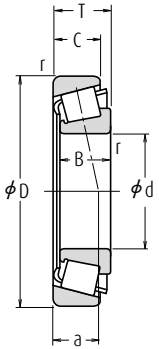
$P_0=0.5F_r+Y_0F_a$

When $F_r>0.5F_r+Y_0F_a$, use $P_0=F_r$

The values of e, $Y_1$ and $Y_0$ are given in the table below.

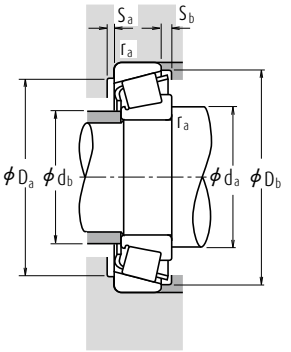
| Bearing Numbers | ISO355 Dimension Series | Abutment and Fillet Dimensions (mm) | | | | | | | | | Eff. Load Centers (mm) | Constant | Axial Load Factors | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Cone | Cup | | | | | |
| | | $d_a$ | $d_b$ | $D_a$ | | $D_b$ | $S_a$ | $S_b$ | $r_a$ | | | | | | |
| | approx. | min. | max. | max. | min. | min. | min. | min. | max. | | a | e | $Y_1$ | $Y_0$ | approx. |
| **HR 32908 J** | 2BC | 48 | 44 | 57 | 57 | 59 | 3 | 3 | 0.6 | 0.6 | 11.5 | 0.29 | 2.1 | 1.1 | 0.161 |
| **HR 32008 XJ** | 3CD | 49 | 45 | 62 | 60 | 65.5 | 4 | 4.5 | 1 | 1 | 15.0 | 0.38 | 1.6 | 0.87 | 0.28 |
| **HR 33008 J** | 2BE | 49 | 45 | 62 | 61 | 65 | 4 | 4 | 1 | 1 | 14.6 | 0.28 | 2.1 | 1.2 | 0.322 |
| **HR 33108 J** | 2CE | 51 | 46 | 66 | 65 | 71 | 4 | 5.5 | 1.5 | 1.5 | 18.0 | 0.36 | 1.7 | 0.93 | 0.503 |
| **HR 30208 J** | 3DB | 51 | 48 | 71 | 69 | 75 | 3 | 3.5 | 1.5 | 1.5 | 16.6 | 0.37 | 1.6 | 0.88 | 0.437 |
| **HR 32208 J** | 3DC | 51 | 48 | 71 | 68 | 75 | 3 | 5.5 | 1.5 | 1.5 | 18.9 | 0.37 | 1.6 | 0.88 | 0.548 |
| **HR 32208 CJ** | 5DC | 51 | 47 | 71 | 65 | 76 | 3 | 5.5 | 1.5 | 1.5 | 21.9 | 0.55 | 1.1 | 0.60 | 0.558 |
| **HR 33208 J** | 2DE | 51 | 46 | 71 | 67 | 76 | 5 | 7 | 1.5 | 1.5 | 20.8 | 0.36 | 1.7 | 0.92 | 0.744 |
| **HR 30308 J** | 2FB | 52 | 52 | 81 | 76 | 82 | 3 | 5 | 2 | 1.5 | 19.5 | 0.35 | 1.7 | 0.96 | 0.758 |
| **HR 30308 C** | — | 52 | 50 | 81 | 72 | 84 | 3 | 7 | 2 | 1.5 | 22.8 | 0.53 | 1.1 | 0.62 | 0.735 |
| **HR 30308 DJ** | 7FB | 56 | 50 | 81 | 70 | 87 | 3 | 8 | 2 | 1.5 | 28.7 | 0.83 | 0.73 | 0.40 | 0.728 |
| **HR 31308 J** | 7FB | 56 | 50 | 81 | 70 | 87 | 3 | 8 | 2 | 1.5 | 28.7 | 0.83 | 0.73 | 0.40 | 0.728 |
| **HR 32308 J** | 2FD | 54 | 50 | 81 | 73 | 82 | 3 | 8 | 2 | 1.5 | 23.4 | 0.35 | 1.7 | 0.96 | 1.05 |
| **HR 32909 J** | 2BC | 53 | 50 | 63 | 62 | 64 | 3 | 3 | 0.6 | 0.6 | 12.3 | 0.32 | 1.9 | 1.0 | 0.187 |
| **HR 32009 XJ** | 3CC | 54 | 51 | 69 | 67 | 72 | 4 | 4.5 | 1 | 1 | 16.6 | 0.39 | 1.5 | 0.84 | 0.354 |
| **HR 33009 J** | 2CE | 54 | 51 | 69 | 67 | 71 | 4 | 5 | 1 | 1 | 16.3 | 0.29 | 2.0 | 1.1 | 0.414 |
| **HR 33109 J** | 3CE | 56 | 51 | 71 | 69 | 77 | 4 | 5.5 | 1.5 | 1.5 | 19.1 | 0.38 | 1.6 | 0.86 | 0.552 |
| **HR 30209 J** | 3DB | 56 | 53 | 76 | 74 | 80 | 3 | 4.5 | 1.5 | 1.5 | 18.3 | 0.41 | 1.5 | 0.81 | 0.488 |
| **HR 32209 J** | 3DC | 56 | 53 | 76 | 73 | 81 | 3 | 5.5 | 1.5 | 1.5 | 20.1 | 0.41 | 1.5 | 0.81 | 0.602 |
| **HR 32209 CJ** | 5DC | 56 | 52 | 76 | 70 | 82 | 3 | 5.5 | 1.5 | 1.5 | 23.6 | 0.59 | 1.0 | 0.56 | 0.603 |
| **HR 33209 J** | 3DE | 56 | 51 | 76 | 72 | 81 | 5 | 7 | 1.5 | 1.5 | 22.0 | 0.39 | 1.6 | 0.86 | 0.817 |
| **T7 FC045** | 7FC | 60 | 53 | 83 | 71 | 91 | 3 | 9 | 2 | 2 | 32.1 | 0.87 | 0.69 | 0.38 | 0.918 |
| **T2 ED045** | 2ED | 60 | 54 | 83 | 79 | 89 | 5 | 6 | 2 | 2 | 23.5 | 0.32 | 1.9 | 1.02 | 1.22 |
| **HR 30309 J** | 2FB | 57 | 58 | 91 | 86 | 93 | 3 | 5 | 2 | 1.5 | 21.1 | 0.35 | 1.7 | 0.96 | 1.01 |
| **HR 30309 DJ** | 7FB | 61 | 57 | 91 | 79 | 96 | 3 | 9 | 2 | 1.5 | 31.5 | 0.83 | 0.73 | 0.40 | 0.957 |
| **HR 31309 J** | 7FB | 61 | 57 | 91 | 79 | 96 | 3 | 9 | 2 | 1.5 | 31.5 | 0.83 | 0.73 | 0.40 | 0.947 |
| **HR 32309 J** | 2FD | 59 | 56 | 91 | 82 | 93 | 3 | 8 | 2 | 1.5 | 25.0 | 0.35 | 1.7 | 0.96 | 1.42 |
| **T2 ED050** | 2ED | 65 | 59 | 88 | 83 | 94 | 6 | 6 | 2 | 2 | 24.2 | 0.34 | 1.8 | 0.96 | 1.3 |
| **HR 32910 J** | 2BC | 58 | 54 | 67 | 66 | 69 | 3 | 3 | 0.6 | 0.6 | 13.5 | 0.34 | 1.8 | 0.97 | 0.193 |
| **HR 32010 XJ** | 3CC | 59 | 56 | 74 | 71 | 77 | 4 | 4.5 | 1 | 1 | 17.9 | 0.42 | 1.4 | 0.78 | 0.38 |
| **HR 33010 J** | 2CE | 59 | 55 | 74 | 71 | 76 | 4 | 5 | 1 | 1 | 17.4 | 0.32 | 1.9 | 1.0 | 0.452 |
| **HR 33110 J** | 3CE | 61 | 56 | 76 | 74 | 82 | 4 | 6 | 1.5 | 1.5 | 20.3 | 0.41 | 1.5 | 0.8 | 0.597 |
| **HR 30210 J** | 3DB | 61 | 58 | 81 | 79 | 85 | 3 | 4.5 | 1.5 | 1.5 | 19.6 | 0.42 | 1.4 | 0.79 | 0.557 |
| **HR 32210 J** | 3DC | 61 | 57 | 81 | 78 | 86 | 3 | 5.5 | 1.5 | 1.5 | 21.0 | 0.42 | 1.4 | 0.79 | 0.642 |
| **HR 32210 CJ** | 5DC | 61 | 58 | 81 | 76 | 87 | 3 | 6.5 | 1.5 | 1.5 | 24.6 | 0.59 | 1.0 | 0.56 | 0.655 |
| **HR 33210 J** | 3DE | 61 | 56 | 81 | 76 | 87 | 5 | 7.5 | 1.5 | 1.5 | 23.2 | 0.41 | 1.5 | 0.80 | 0.867 |
| **T7 FC050** | 7FC | 74 | 59 | 91 | 78 | 100 | 5 | 10 | 2.5 | 2.5 | 36.4 | 0.87 | 0.69 | 0.38 | 1.22 |
| **HR 30310 J** | 2FB | 65 | 65 | 100 | 95 | 102 | 3 | 6 | 2 | 2 | 23.1 | 0.35 | 1.7 | 0.96 | 1.28 |
| **HR 30310 DJ** | 7FB | 70 | 62 | 100 | 87 | 105 | 3 | 10 | 2 | 2 | 34.3 | 0.83 | 0.73 | 0.40 | 1.26 |
| **HR 31310 J** | 7FB | 70 | 62 | 100 | 87 | 105 | 3 | 10 | 2 | 2 | 34.3 | 0.83 | 0.73 | 0.40 | 1.26 |
| **HR 32310 J** | 2FD | 68 | 62 | 100 | 91 | 102 | 3 | 9 | 2 | 2 | 28.0 | 0.35 | 1.7 | 0.96 | 1.88 |
| **HR 32310 CJ** | 5FD | 68 | 59 | 100 | 82 | 103 | 3 | 9 | 2 | 2 | 32.8 | 0.55 | 1.1 | 0.60 | 1.93 |

## Bore Diameter 55 – 65 mm




| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Limiting Speeds (min⁻¹) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cone r min. | Cup r min. | | | | |
| d | D | T | B | C | | | $C_r$ | $C_{0r}$ | Grease | Oil |
| **55** | 80 | 17 | 17 | 14 | 1 | 1 | 45 500 | 74 500 | 4 300 | 5 600 |
| | 90 | 23 | 23 | 17.5 | 1.5 | 1.5 | 81 500 | 117 000 | 3 800 | 5 300 |
| | 90 | 27 | 27 | 21 | 1.5 | 1.5 | 91 500 | 138 000 | 3 800 | 5 300 |
| | 95 | 30 | 30 | 23 | 1.5 | 1.5 | 112 000 | 158 000 | 3 800 | 5 000 |
| | 100 | 22.75 | 21 | 18 | 2 | 1.5 | 94 500 | 113 000 | 3 600 | 5 000 |
| | 100 | 26.75 | 25 | 21 | 2 | 1.5 | 110 000 | 137 000 | 3 600 | 5 000 |
| | 100 | 35 | 35 | 27 | 2 | 1.5 | 141 000 | 193 000 | 3 600 | 5 000 |
| | 115 | 34 | 31 | 23.5 | 3 | 3 | 126 000 | 164 000 | 3 000 | 4 300 |
| | 120 | 31.5 | 29 | 25 | 2.5 | 2 | 150 000 | 171 000 | 3 200 | 4 300 |
| | 120 | 31.5 | 29 | 21 | 2.5 | 2 | 131 000 | 153 000 | 2 800 | 4 000 |
| | 120 | 31.5 | 29 | 21 | 2.5 | 2 | 131 000 | 153 000 | 2 800 | 4 000 |
| | 120 | 45.5 | 43 | 35 | 2.5 | 2 | 204 000 | 258 000 | 3 200 | 4 300 |
| | 120 | 45.5 | 43 | 35 | 2.5 | 2 | 195 000 | 262 000 | 3 200 | 4 300 |
| **60** | 85 | 17 | 17 | 14 | 1 | 1 | 49 000 | 84 500 | 3 800 | 5 300 |
| | 95 | 23 | 23 | 17.5 | 1.5 | 1.5 | 85 500 | 127 000 | 3 600 | 5 000 |
| | 95 | 27 | 27 | 21 | 1.5 | 1.5 | 96 000 | 150 000 | 3 600 | 5 000 |
| | 100 | 30 | 30 | 23 | 1.5 | 1.5 | 115 000 | 166 000 | 3 400 | 4 800 |
| | 110 | 23.75 | 22 | 19 | 2 | 1.5 | 104 000 | 123 000 | 3 400 | 4 500 |
| | 110 | 29.75 | 28 | 24 | 2 | 1.5 | 131 000 | 167 000 | 3 400 | 4 500 |
| | 110 | 38 | 38 | 29 | 2 | 1.5 | 166 000 | 231 000 | 3 400 | 4 500 |
| | 125 | 37 | 33.5 | 26 | 3 | 3 | 151 000 | 197 000 | 2 800 | 3 800 |
| | 130 | 33.5 | 31 | 26 | 3 | 2.5 | 174 000 | 201 000 | 3 000 | 4 000 |
| | 130 | 33.5 | 31 | 22 | 3 | 2.5 | 151 000 | 177 000 | 2 600 | 3 800 |
| | 130 | 33.5 | 31 | 22 | 3 | 2.5 | 151 000 | 177 000 | 2 600 | 3 800 |
| | 130 | 48.5 | 46 | 37 | 3 | 2.5 | 233 000 | 295 000 | 3 000 | 4 000 |
| | 130 | 48.5 | 46 | 35 | 3 | 2.5 | 196 000 | 249 000 | 2 800 | 3 800 |
| **65** | 90 | 17 | 17 | 14 | 1 | 1 | 49 000 | 86 500 | 3 600 | 5 000 |
| | 100 | 23 | 23 | 17.5 | 1.5 | 1.5 | 86 500 | 132 000 | 3 400 | 4 500 |
| | 100 | 27 | 27 | 21 | 1.5 | 1.5 | 97 500 | 156 000 | 3 400 | 4 500 |
| | 110 | 34 | 34 | 26.5 | 1.5 | 1.5 | 148 000 | 218 000 | 3 200 | 4 300 |
| | 120 | 24.75 | 23 | 20 | 2 | 1.5 | 122 000 | 151 000 | 3 000 | 4 000 |
| | 120 | 32.75 | 31 | 27 | 2 | 1.5 | 157 000 | 202 000 | 3 000 | 4 000 |
| | 120 | 41 | 41 | 32 | 2 | 1.5 | 202 000 | 282 000 | 3 000 | 4 000 |
| | 140 | 36 | 33 | 28 | 3 | 2.5 | 200 000 | 233 000 | 2 600 | 3 600 |
| | 140 | 36 | 33 | 23 | 3 | 2.5 | 173 000 | 205 000 | 2 400 | 3 400 |
| | 140 | 36 | 33 | 23 | 3 | 2.5 | 173 000 | 205 000 | 2 400 | 3 400 |
| | 140 | 51 | 48 | 39 | 3 | 2.5 | 267 000 | 340 000 | 2 800 | 3 800 |

**Remark** The suffix C represents medium-angle tapered roller bearings. Since they are designed for specific applications, please consult NSK when using bearings with suffix C.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | 0 | 0.4 | $Y_1$ |

## Static Equivalent Load

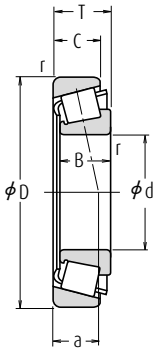
$P_0=0.5F_r+Y_0F_a$

When $F_r>0.5F_r+Y_0F_a$, use $P_0=F_r$

The values of e, $Y_1$ and $Y_0$ are given in the table below.

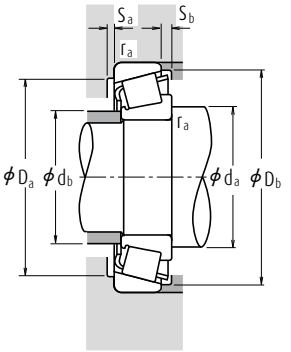
| Bearing Numbers | ISO355 Dimension Series | Abutment and Fillet Dimensions (mm) | | | | | | | | | Eff. Load Centers (mm) | Constant | Axial Load Factors | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Cone | Cup | | | | | |
| | | $d_a$ | $d_b$ | $D_a$ | | $D_b$ | $S_a$ | $S_b$ | $r_a$ | | | | | | |
| | approx. | min. | max. | max. | min. | min. | min. | min. | max. | | a | e | $Y_1$ | $Y_0$ | approx. |
| **HR 32911 J** | 2BC | 64 | 60 | 74 | 73 | 76 | 4 | 3 | 1 | 1 | 14.6 | 0.31 | 1.9 | 1.1 | 0.282 |
| **HR 32011 XJ** | 3CC | 66 | 62 | 81 | 80 | 86 | 4 | 5.5 | 1.5 | 1.5 | 19.7 | 0.41 | 1.5 | 0.81 | 0.568 |
| **HR 33011 J** | 2CE | 66 | 62 | 81 | 80 | 86 | 5 | 6 | 1.5 | 1.5 | 19.2 | 0.31 | 1.9 | 1.1 | 0.657 |
| **HR 33111 J** | 3CE | 66 | 62 | 86 | 82 | 91 | 5 | 7 | 1.5 | 1.5 | 22.4 | 0.37 | 1.6 | 0.88 | 0.877 |
| **HR 30211 J** | 3DB | 67 | 64 | 91 | 89 | 94 | 4 | 4.5 | 2 | 1.5 | 20.9 | 0.41 | 1.5 | 0.81 | 0.736 |
| **HR 32211 J** | 3DC | 67 | 63 | 91 | 87 | 95 | 4 | 5.5 | 2 | 1.5 | 22.7 | 0.41 | 1.5 | 0.81 | 0.859 |
| **HR 33211 J** | 3DE | 67 | 62 | 91 | 86 | 96 | 6 | 8 | 2 | 1.5 | 25.2 | 0.40 | 1.5 | 0.83 | 1.18 |
| **T7 FC055** | 7FC | 73 | 66 | 101 | 86 | 109 | 4 | 10.5 | 2.5 | 2.5 | 39.0 | 0.87 | 0.69 | 0.38 | 1.58 |
| **HR 30311 J** | 2FB | 70 | 71 | 110 | 104 | 111 | 4 | 6.5 | 2 | 2 | 24.6 | 0.35 | 1.7 | 0.96 | 1.63 |
| **HR 30311 DJ** | 7FB | 75 | 67 | 110 | 94 | 114 | 4 | 10.5 | 2 | 2 | 37.0 | 0.83 | 0.73 | 0.40 | 1.58 |
| **HR 31311 J** | 7FB | 75 | 67 | 110 | 94 | 114 | 4 | 10.5 | 2 | 2 | 37.0 | 0.83 | 0.73 | 0.40 | 1.58 |
| **HR 32311 J** | 2FD | 73 | 67 | 110 | 99 | 111 | 4 | 10.5 | 2 | 2 | 29.9 | 0.35 | 1.7 | 0.96 | 2.39 |
| **HR 32311 CJ** | 5FD | 73 | 65 | 110 | 91 | 112 | 4 | 10.5 | 2 | 2 | 35.8 | 0.55 | 1.1 | 0.60 | 2.47 |
| **HR 32912 J** | 2BC | 69 | 65 | 79 | 78 | 81 | 4 | 3 | 1 | 1 | 15.5 | 0.33 | 1.8 | 1.0 | 0.306 |
| **HR 32012 XJ** | 4CC | 71 | 66 | 86 | 85 | 91 | 4 | 5.5 | 1.5 | 1.5 | 20.9 | 0.43 | 1.4 | 0.77 | 0.608 |
| **HR 33012 J** | 2CE | 71 | 66 | 86 | 85 | 90 | 5 | 6 | 1.5 | 1.5 | 20.0 | 0.33 | 1.8 | 1.0 | 0.713 |
| **HR 33112 J** | 3CE | 71 | 68 | 91 | 88 | 96 | 5 | 7 | 1.5 | 1.5 | 23.6 | 0.40 | 1.5 | 0.83 | 0.91 |
| **HR 30212 J** | 3EB | 72 | 69 | 101 | 96 | 103 | 4 | 4.5 | 2 | 1.5 | 22.0 | 0.41 | 1.5 | 0.81 | 0.930 |
| **HR 32212 J** | 3EC | 72 | 68 | 101 | 95 | 104 | 4 | 5.5 | 2 | 1.5 | 24.1 | 0.41 | 1.5 | 0.81 | 1.18 |
| **HR 33212 J** | 3EE | 72 | 68 | 101 | 94 | 105 | 6 | 9 | 2 | 1.5 | 27.6 | 0.40 | 1.5 | 0.82 | 1.56 |
| **T7 FC060** | 7FC | 78 | 72 | 111 | 94 | 119 | 4 | 11 | 2.5 | 2.5 | 41.4 | 0.82 | 0.73 | 0.40 | 2.03 |
| **HR 30312 J** | 2FB | 78 | 77 | 118 | 112 | 120 | 4 | 7.5 | 2.5 | 2 | 26.0 | 0.35 | 1.7 | 0.96 | 2.03 |
| **HR 30312 DJ** | 7FB | 84 | 74 | 118 | 103 | 125 | 4 | 11.5 | 2.5 | 2 | 40.3 | 0.83 | 0.73 | 0.40 | 1.98 |
| **HR 31312 J** | 7FB | 84 | 74 | 118 | 103 | 125 | 4 | 11.5 | 2.5 | 2 | 40.3 | 0.83 | 0.73 | 0.40 | 1.98 |
| **HR 32312 J** | 2FD | 81 | 74 | 118 | 107 | 120 | 4 | 11.5 | 2.5 | 2 | 31.4 | 0.35 | 1.7 | 0.96 | 2.96 |
| **32312 C** | — | 81 | 74 | 116 | 102 | 125 | 4 | 13.5 | 2.5 | 2 | 39.9 | 0.58 | 1.0 | 0.57 | 2.86 |
| **HR 32913 J** | 2BC | 74 | 70 | 84 | 82 | 86 | 4 | 3 | 1 | 1 | 16.8 | 0.35 | 1.7 | 0.93 | 0.323 |
| **HR 32013 XJ** | 4CC | 76 | 71 | 91 | 90 | 97 | 4 | 5.5 | 1.5 | 1.5 | 22.4 | 0.46 | 1.3 | 0.72 | 0.646 |
| **HR 33013 J** | 2CE | 76 | 71 | 91 | 90 | 96 | 5 | 6 | 1.5 | 1.5 | 21.1 | 0.35 | 1.7 | 0.95 | 0.76 |
| **HR 33113 J** | 3DE | 76 | 73 | 101 | 96 | 106 | 6 | 7.5 | 1.5 | 1.5 | 26.0 | 0.39 | 1.5 | 0.85 | 1.32 |
| **HR 30213 J** | 3EB | 77 | 78 | 111 | 106 | 113 | 4 | 4.5 | 2 | 1.5 | 23.8 | 0.41 | 1.5 | 0.81 | 1.18 |
| **HR 32213 J** | 3EC | 77 | 75 | 111 | 104 | 115 | 4 | 5.5 | 2 | 1.5 | 27.1 | 0.41 | 1.5 | 0.81 | 1.55 |
| **HR 33213 J** | 3EE | 77 | 74 | 111 | 102 | 115 | 6 | 9 | 2 | 1.5 | 29.2 | 0.39 | 1.5 | 0.85 | 2.04 |
| **HR 30313 J** | 2GB | 83 | 83 | 128 | 121 | 130 | 4 | 8 | 2.5 | 2 | 27.9 | 0.35 | 1.7 | 0.96 | 2.51 |
| **HR 30313 DJ** | 7GB | 89 | 80 | 128 | 111 | 133 | 4 | 13 | 2.5 | 2 | 43.2 | 0.83 | 0.73 | 0.40 | 2.43 |
| **HR 31313 J** | 7GB | 89 | 80 | 128 | 111 | 133 | 4 | 13 | 2.5 | 2 | 43.2 | 0.83 | 0.73 | 0.40 | 2.43 |
| **HR 32313 J** | 2GD | 86 | 80 | 128 | 116 | 130 | 4 | 12 | 2.5 | 2 | 34.0 | 0.35 | 1.7 | 0.96 | 3.6 |

## Bore Diameter 70 – 80 mm




| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Limiting Speeds (min$^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cone | Cup | | | | |
| d | D | T | B | C | r min. | | $C_r$ | $C_{0r}$ | Grease | Oil |
| **70** | 100 | 20 | 20 | 16 | 1 | 1 | 70 000 | 113 000 | 3 200 | 4 500 |
| | 110 | 25 | 25 | 19 | 1.5 | 1.5 | 104 000 | 158 000 | 3 200 | 4 300 |
| | 110 | 31 | 31 | 25.5 | 1.5 | 1.5 | 127 000 | 204 000 | 3 000 | 4 300 |
| | 120 | 37 | 37 | 29 | 2 | 1.5 | 177 000 | 262 000 | 3 000 | 4 000 |
| | 125 | 26.25 | 24 | 21 | 2 | 1.5 | 132 000 | 163 000 | 2 800 | 4 000 |
| | 125 | 33.25 | 31 | 27 | 2 | 1.5 | 157 000 | 205 000 | 2 800 | 4 000 |
| | 125 | 41 | 41 | 32 | 2 | 1.5 | 209 000 | 299 000 | 2 800 | 4 000 |
| | 140 | 39 | 35.5 | 27 | 3 | 3 | 178 000 | 235 000 | 2 400 | 3 400 |
| | 150 | 38 | 35 | 30 | 3 | 2.5 | 227 000 | 268 000 | 2 400 | 3 400 |
| | 150 | 38 | 35 | 25 | 3 | 2.5 | 192 000 | 229 000 | 2 200 | 3 200 |
| | 150 | 38 | 35 | 25 | 3 | 2.5 | 192 000 | 229 000 | 2 200 | 3 200 |
| | 150 | 54 | 51 | 42 | 3 | 2.5 | 300 000 | 390 000 | 2 600 | 3 400 |
| | 150 | 54 | 51 | 42 | 3 | 2.5 | 280 000 | 390 000 | 2 400 | 3 400 |
| **75** | 105 | 20 | 20 | 16 | 1 | 1 | 72 500 | 120 000 | 3 200 | 4 300 |
| | 115 | 25 | 25 | 19 | 1.5 | 1.5 | 109 000 | 171 000 | 3 000 | 4 000 |
| | 115 | 31 | 31 | 25.5 | 1.5 | 1.5 | 133 000 | 220 000 | 3 000 | 4 000 |
| | 125 | 37 | 37 | 29 | 2 | 2 | 182 000 | 275 000 | 2 800 | 3 800 |
| | 130 | 27.25 | 25 | 22 | 2 | 1.5 | 143 000 | 182 000 | 2 800 | 3 800 |
| | 130 | 33.25 | 31 | 27 | 2 | 1.5 | 165 000 | 219 000 | 2 800 | 3 800 |
| | 130 | 41 | 41 | 31 | 2 | 1.5 | 215 000 | 315 000 | 2 800 | 3 800 |
| | 160 | 40 | 37 | 31 | 3 | 2.5 | 253 000 | 300 000 | 2 400 | 3 200 |
| | 160 | 40 | 37 | 26 | 3 | 2.5 | 211 000 | 251 000 | 2 200 | 3 000 |
| | 160 | 40 | 37 | 26 | 3 | 2.5 | 211 000 | 251 000 | 2 200 | 3 000 |
| | 160 | 58 | 55 | 45 | 3 | 2.5 | 340 000 | 445 000 | 2 400 | 3 200 |
| | 160 | 58 | 55 | 43 | 3 | 2.5 | 310 000 | 420 000 | 2 200 | 3 200 |
| **80** | 110 | 20 | 20 | 16 | 1 | 1 | 75 000 | 128 000 | 3 000 | 4 000 |
| | 125 | 29 | 29 | 22 | 1.5 | 1.5 | 140 000 | 222 000 | 2 800 | 3 600 |
| | 125 | 36 | 36 | 29.5 | 1.5 | 1.5 | 172 000 | 282 000 | 2 800 | 3 600 |
| | 130 | 37 | 37 | 29 | 2 | 1.5 | 186 000 | 289 000 | 2 600 | 3 600 |
| | 140 | 28.25 | 26 | 22 | 2.5 | 2 | 157 000 | 195 000 | 2 600 | 3 400 |
| | 140 | 28.25 | 26 | 20 | 2.5 | 2 | 147 000 | 190 000 | 2 400 | 3 400 |
| | 140 | 35.25 | 33 | 28 | 2.5 | 2 | 192 000 | 254 000 | 2 600 | 3 400 |
| | 140 | 46 | 46 | 35 | 2.5 | 2 | 256 000 | 385 000 | 2 600 | 3 400 |
| | 170 | 42.5 | 39 | 33 | 3 | 2.5 | 276 000 | 330 000 | 2 200 | 3 000 |
| | 170 | 42.5 | 39 | 27 | 3 | 2.5 | 235 000 | 283 000 | 2 000 | 2 800 |
| | 170 | 42.5 | 39 | 27 | 3 | 2.5 | 235 000 | 283 000 | 2 000 | 2 800 |
| | 170 | 61.5 | 58 | 48 | 3 | 2.5 | 385 000 | 505 000 | 2 200 | 3 000 |
| | 170 | 61.5 | 58 | 48 | 3 | 2.5 | 365 000 | 530 000 | 2 200 | 3 000 |

**Remark** The suffix CA represents medium-angle tapered roller bearings. Since they are designed for specific applications, please consult NSK when using bearings with suffix CA.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | 0 | 0.4 | $Y_1$ |

## Static Equivalent Load

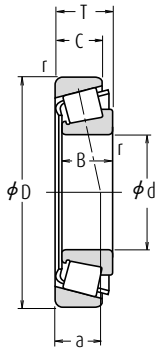
$P_0=0.5F_r+Y_0F_a$

When $F_r>0.5F_r+Y_0F_a$, use $P_0=F_r$

The values of e, $Y_1$ and $Y_0$ are given in the table below.

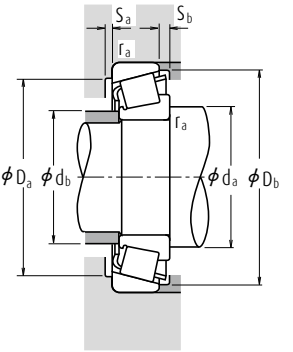
| Bearing Numbers | ISO355 Dimension Series | Abutment and Fillet Dimensions (mm) | | | | | | | | | Eff. Load Centers (mm) | Constant | Axial Load Factors | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Cone | Cup | | | | | |
| | | $d_a$ | $d_b$ | $D_a$ | | $D_b$ | $S_a$ | $S_b$ | $r_a$ | | | | | | |
| | approx. | min. | max. | max. | min. | min. | min. | min. | max. | | a | e | $Y_1$ | $Y_0$ | approx. |
| **HR 32914 J** | 2BC | 79 | 76 | 94 | 93 | 96 | 4 | 4 | 1 | 1 | 17.6 | 0.32 | 1.9 | 1.1 | 0.494 |
| **HR 32014 XJ** | 4CC | 81 | 77 | 101 | 98 | 105 | 5 | 6 | 1.5 | 1.5 | 23.7 | 0.43 | 1.4 | 0.76 | 0.869 |
| **HR 33014 J** | 2CE | 81 | 78 | 101 | 100 | 105 | 5 | 5.5 | 1.5 | 1.5 | 22.2 | 0.28 | 2.1 | 1.2 | 1.11 |
| **HR 33114 J** | 3DE | 82 | 79 | 111 | 104 | 115 | 6 | 8 | 2 | 1.5 | 27.9 | 0.38 | 1.6 | 0.87 | 1.71 |
| **HR 30214 J** | 3EB | 82 | 81 | 116 | 110 | 118 | 4 | 5 | 2 | 1.5 | 25.6 | 0.42 | 1.4 | 0.79 | 1.3 |
| **HR 32214 J** | 3EC | 82 | 80 | 116 | 108 | 119 | 4 | 6 | 2 | 1.5 | 28.6 | 0.42 | 1.4 | 0.79 | 1.66 |
| **HR 33214 J** | 3EE | 82 | 78 | 116 | 107 | 120 | 7 | 9 | 2 | 1.5 | 30.4 | 0.41 | 1.5 | 0.81 | 2.15 |
| **T7 FC070** | 7FC | 88 | 81 | 126 | 106 | 133 | 5 | 12 | 2.5 | 2.5 | 46.4 | 0.87 | 0.69 | 0.38 | 2.58 |
| **HR 30314 J** | 2GB | 88 | 89 | 138 | 132 | 140 | 4 | 8 | 2.5 | 2 | 29.7 | 0.35 | 1.7 | 0.96 | 3.03 |
| **HR 30314 DJ** | 7GB | 94 | 85 | 138 | 118 | 142 | 4 | 13 | 2.5 | 2 | 45.8 | 0.83 | 0.73 | 0.40 | 2.94 |
| **HR 31314 J** | 7GB | 94 | 85 | 138 | 118 | 142 | 4 | 13 | 2.5 | 2 | 45.8 | 0.83 | 0.73 | 0.40 | 2.94 |
| **HR 32314 J** | 2GD | 91 | 86 | 138 | 124 | 140 | 4 | 12 | 2.5 | 2 | 36.1 | 0.35 | 1.7 | 0.96 | 4.35 |
| **HR 32314 CJ** | 5GD | 91 | 84 | 138 | 115 | 141 | 4 | 12 | 2.5 | 2 | 43.3 | 0.55 | 1.1 | 0.60 | 4.47 |
| **HR 32915 J** | 2BC | 84 | 81 | 99 | 98 | 101 | 4 | 4 | 1 | 1 | 18.7 | 0.33 | 1.8 | 0.99 | 0.53 |
| **HR 32015 XJ** | 4CC | 86 | 82 | 106 | 103 | 110 | 5 | 6 | 1.5 | 1.5 | 25.1 | 0.46 | 1.3 | 0.72 | 0.925 |
| **HR 33015 J** | 2CE | 86 | 83 | 106 | 104 | 110 | 6 | 5.5 | 1.5 | 1.5 | 23.0 | 0.30 | 2.0 | 1.1 | 1.18 |
| **HR 33115 J** | 3DE | 87 | 83 | 115 | 109 | 120 | 6 | 8 | 2 | 2 | 29.2 | 0.40 | 1.5 | 0.83 | 1.8 |
| **HR 30215 J** | 4DB | 87 | 85 | 121 | 115 | 124 | 4 | 5 | 2 | 1.5 | 27.0 | 0.44 | 1.4 | 0.76 | 1.43 |
| **HR 32215 J** | 4DC | 87 | 84 | 121 | 113 | 125 | 4 | 6 | 2 | 1.5 | 29.8 | 0.44 | 1.4 | 0.76 | 1.72 |
| **HR 33215 J** | 3EE | 87 | 83 | 121 | 111 | 125 | 7 | 10 | 2 | 1.5 | 31.6 | 0.43 | 1.4 | 0.77 | 2.25 |
| **HR 30315 J** | 2GB | 93 | 95 | 148 | 141 | 149 | 4 | 9 | 2.5 | 2 | 31.8 | 0.35 | 1.7 | 0.96 | 3.63 |
| **HR 30315 DJ** | 7GB | 99 | 91 | 148 | 129 | 152 | 6 | 14 | 2.5 | 2 | 48.8 | 0.83 | 0.73 | 0.40 | 3.47 |
| **HR 31315 J** | 7GB | 99 | 91 | 148 | 129 | 152 | 6 | 14 | 2.5 | 2 | 48.8 | 0.83 | 0.73 | 0.40 | 3.47 |
| **HR 32315 J** | 2GD | 96 | 91 | 148 | 134 | 149 | 4 | 13 | 2.5 | 2 | 38.9 | 0.35 | 1.7 | 0.96 | 5.31 |
| **32315 CA** | — | 96 | 90 | 148 | 124 | 153 | 4 | 15 | 2.5 | 2 | 47.7 | 0.58 | 1.0 | 0.57 | 5.3 |
| **HR 32916 J** | 2BC | 89 | 85 | 104 | 102 | 106 | 4 | 4 | 1 | 1 | 19.8 | 0.35 | 1.7 | 0.94 | 0.56 |
| **HR 32016 XJ** | 3CC | 91 | 89 | 116 | 112 | 120 | 6 | 7 | 1.5 | 1.5 | 26.9 | 0.42 | 1.4 | 0.78 | 1.32 |
| **HR 33016 J** | 2CE | 91 | 88 | 116 | 112 | 119 | 6 | 6.5 | 1.5 | 1.5 | 25.5 | 0.28 | 2.2 | 1.2 | 1.66 |
| **HR 33116 J** | 3DE | 82 | 88 | 121 | 113 | 126 | 6 | 8 | 2 | 1.5 | 30.4 | 0.42 | 1.4 | 0.79 | 1.88 |
| **HR 30216 J** | 3EB | 95 | 91 | 130 | 124 | 132 | 4 | 6 | 2 | 2 | 28.1 | 0.42 | 1.4 | 0.79 | 1.68 |
| **30216 CA** | — | 95 | 92 | 130 | 122 | 133 | 4 | 8 | 2 | 2 | 33.8 | 0.58 | 1.0 | 0.57 | 1.66 |
| **HR 32216 J** | 3EC | 95 | 90 | 130 | 122 | 134 | 4 | 7 | 2 | 2 | 30.6 | 0.42 | 1.4 | 0.79 | 2.13 |
| **HR 33216 J** | 3EE | 95 | 89 | 130 | 119 | 135 | 7 | 11 | 2 | 2 | 34.8 | 0.43 | 1.4 | 0.78 | 2.93 |
| **HR 30316 J** | 2GB | 98 | 102 | 158 | 150 | 159 | 4 | 9.5 | 2.5 | 2 | 34.0 | 0.35 | 1.7 | 0.96 | 4.27 |
| **HR 30316 DJ** | 7GB | 104 | 97 | 158 | 136 | 159 | 6 | 15.5 | 2.5 | 2 | 51.8 | 0.83 | 0.73 | 0.40 | 4.07 |
| **HR 31316 J** | 7GB | 104 | 97 | 158 | 136 | 159 | 6 | 15.5 | 2.5 | 2 | 51.8 | 0.83 | 0.73 | 0.40 | 4.07 |
| **HR 32316 J** | 2GD | 101 | 98 | 158 | 143 | 159 | 4 | 13.5 | 2.5 | 2 | 41.4 | 0.35 | 1.7 | 0.96 | 6.35 |
| **HR 32316 CJ** | 5GD | 101 | 95 | 158 | 132 | 160 | 4 | 13.5 | 2.5 | 2 | 49.3 | 0.55 | 1.1 | 0.60 | 6.59 |

## Bore Diameter 85 – 100 mm




| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Limiting Speeds (min⁻¹) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cone | Cup | | | | |
| d | D | T | B | C | r min. | | $C_r$ | $C_{0r}$ | Grease | Oil |
| **85** | 120 | 23 | 23 | 18 | 1.5 | 1.5 | 93 500 | 157 000 | 2 800 | 3 800 |
| | 130 | 29 | 29 | 22 | 1.5 | 1.5 | 143 000 | 231 000 | 2 600 | 3 600 |
| | 130 | 36 | 36 | 29.5 | 1.5 | 1.5 | 180 000 | 305 000 | 2 600 | 3 600 |
| | 140 | 41 | 41 | 32 | 2.5 | 2 | 230 000 | 365 000 | 2 400 | 3 400 |
| | 150 | 30.5 | 28 | 24 | 2.5 | 2 | 184 000 | 233 000 | 2 400 | 3 200 |
| | 150 | 30.5 | 28 | 22 | 2.5 | 2 | 171 000 | 226 000 | 2 200 | 3 200 |
| | 150 | 38.5 | 36 | 30 | 2.5 | 2 | 210 000 | 277 000 | 2 200 | 3 200 |
| | 150 | 49 | 49 | 37 | 2.5 | 2 | 281 000 | 415 000 | 2 400 | 3 200 |
| | 180 | 44.5 | 41 | 34 | 4 | 3 | 310 000 | 375 000 | 2 000 | 2 800 |
| | 180 | 44.5 | 41 | 28 | 4 | 3 | 261 000 | 315 000 | 1 900 | 2 600 |
| | 180 | 44.5 | 41 | 28 | 4 | 3 | 261 000 | 315 000 | 1 900 | 2 600 |
| | 180 | 63.5 | 60 | 49 | 4 | 3 | 410 000 | 535 000 | 2 000 | 2 800 |
| **90** | 125 | 23 | 23 | 18 | 1.5 | 1.5 | 97 000 | 167 000 | 2 600 | 3 600 |
| | 140 | 32 | 32 | 24 | 2 | 1.5 | 170 000 | 273 000 | 2 400 | 3 200 |
| | 140 | 39 | 39 | 32.5 | 2 | 1.5 | 220 000 | 360 000 | 2 400 | 3 200 |
| | 150 | 45 | 45 | 35 | 2.5 | 2 | 259 000 | 405 000 | 2 400 | 3 200 |
| | 160 | 32.5 | 30 | 26 | 2.5 | 2 | 201 000 | 256 000 | 2 200 | 3 000 |
| | 160 | 42.5 | 40 | 34 | 2.5 | 2 | 256 000 | 350 000 | 2 200 | 3 000 |
| | 190 | 46.5 | 43 | 36 | 4 | 3 | 345 000 | 425 000 | 1 900 | 2 600 |
| | 190 | 46.5 | 43 | 30 | 4 | 3 | 264 000 | 315 000 | 1 800 | 2 400 |
| | 190 | 46.5 | 43 | 30 | 4 | 3 | 264 000 | 315 000 | 1 800 | 2 400 |
| | 190 | 67.5 | 64 | 53 | 4 | 3 | 450 000 | 590 000 | 2 000 | 2 600 |
| **95** | 130 | 23 | 23 | 18 | 1.5 | 1.5 | 98 000 | 172 000 | 2 400 | 3 400 |
| | 145 | 32 | 32 | 24 | 2 | 1.5 | 173 000 | 283 000 | 2 400 | 3 200 |
| | 145 | 39 | 39 | 32.5 | 2 | 1.5 | 231 000 | 390 000 | 2 400 | 3 200 |
| | 160 | 46 | 46 | 38 | 3 | 3 | 283 000 | 445 000 | 2 200 | 3 000 |
| | 170 | 34.5 | 32 | 27 | 3 | 2.5 | 223 000 | 286 000 | 2 200 | 2 800 |
| | 170 | 45.5 | 43 | 37 | 3 | 2.5 | 289 000 | 400 000 | 2 200 | 2 800 |
| | 200 | 49.5 | 45 | 38 | 4 | 3 | 370 000 | 455 000 | 1 900 | 2 600 |
| | 200 | 49.5 | 45 | 36 | 4 | 3 | 350 000 | 435 000 | 1 800 | 2 400 |
| | 200 | 49.5 | 45 | 32 | 4 | 3 | 310 000 | 375 000 | 1 700 | 2 400 |
| | 200 | 49.5 | 45 | 32 | 4 | 3 | 310 000 | 375 000 | 1 700 | 2 400 |
| | 200 | 71.5 | 67 | 55 | 4 | 3 | 525 000 | 710 000 | 1 900 | 2 600 |
| **100** | 140 | 25 | 25 | 20 | 1.5 | 1.5 | 117 000 | 205 000 | 2 200 | 3 200 |
| | 145 | 24 | 22.5 | 17.5 | 3 | 3 | 113 000 | 163 000 | 2 200 | 3 000 |
| | 150 | 32 | 32 | 24 | 2 | 1.5 | 176 000 | 294 000 | 2 200 | 3 000 |
| | 150 | 39 | 39 | 32.5 | 2 | 1.5 | 235 000 | 405 000 | 2 200 | 3 000 |
| | 165 | 52 | 52 | 40 | 2.5 | 2 | 315 000 | 515 000 | 2 000 | 2 800 |
| | 180 | 37 | 34 | 29 | 3 | 2.5 | 255 000 | 330 000 | 2 000 | 2 600 |
| | 180 | 49 | 46 | 39 | 3 | 2.5 | 325 000 | 450 000 | 2 000 | 2 600 |
| | 180 | 63 | 63 | 48 | 3 | 2.5 | 410 000 | 635 000 | 2 000 | 2 600 |
| | 215 | 51.5 | 47 | 39 | 4 | 3 | 425 000 | 525 000 | 1 700 | 2 400 |
| | 215 | 56.5 | 51 | 35 | 4 | 3 | 385 000 | 505 000 | 1 500 | 2 200 |
| | 215 | 77.5 | 73 | 60 | 4 | 3 | 565 000 | 755 000 | 1 700 | 2 400 |

**Remark** The suffix CA represents medium-angle tapered roller bearings. Since they are designed for specific applications, please consult NSK when using bearings with suffix CA.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | 0 | 0.4 | $Y_1$ |

## Static Equivalent Load

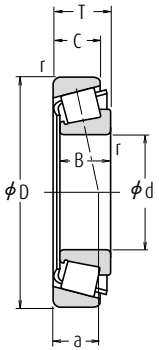
$P_0=0.5F_r+Y_0F_a$

When $F_r>0.5F_r+Y_0F_a$, use $P_0=F_r$

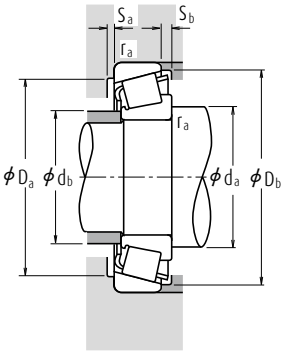
The values of e, $Y_1$ and $Y_0$ are given in the table below.

| Bearing Numbers | ISO355 Dimension Series | Abutment and Fillet Dimensions (mm) | | | | | | | | | Eff. Load Centers (mm) | Constant | Axial Load Factors | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Cone | Cup | | | | | |
| | approx. | $d_a$ min. | $d_b$ max. | $D_a$ max. | $D_a$ min. | $D_b$ min. | $S_a$ min. | $S_b$ min. | $r_a$ max. | | a | e | $Y_1$ | $Y_0$ | approx. |
| **HR 32917 J** | 2BC | 96 | 92 | 111 | 111 | 115 | 5 | 5 | 1.5 | 1.5 | 20.9 | 0.33 | 1.8 | 1.0 | 0.8 |
| **HR 32017 XJ** | 4CC | 96 | 94 | 121 | 116 | 125 | 6 | 7 | 1.5 | 1.5 | 28.2 | 0.44 | 1.4 | 0.75 | 1.38 |
| **HR 33017 J** | 2CE | 96 | 94 | 121 | 117 | 125 | 6 | 6.5 | 1.5 | 1.5 | 26.5 | 0.29 | 2.1 | 1.1 | 1.75 |
| **HR 33117 J** | 3DE | 100 | 94 | 130 | 122 | 135 | 7 | 9 | 2 | 2 | 32.7 | 0.41 | 1.5 | 0.81 | 2.51 |
| **HR 30217 J** | 3EB | 100 | 97 | 140 | 133 | 141 | 5 | 6.5 | 2 | 2 | 30.3 | 0.42 | 1.4 | 0.79 | 2.12 |
| **30217 CA** | — | 100 | 98 | 140 | 131 | 142 | 5 | 8.5 | 2 | 2 | 36.2 | 0.58 | 1.0 | 0.57 | 2.07 |
| **HR 32217 J** | 3EC | 100 | 96 | 140 | 131 | 142 | 5 | 8.5 | 2 | 2 | 33.9 | 0.42 | 1.4 | 0.79 | 2.64 |
| **HR 33217 J** | 3EE | 100 | 95 | 140 | 129 | 144 | 7 | 12 | 2 | 2 | 37.3 | 0.42 | 1.4 | 0.79 | 3.57 |
| **HR 30317 J** | 2GB | 106 | 108 | 166 | 157 | 167 | 5 | 10.5 | 3 | 2.5 | 35.8 | 0.35 | 1.7 | 0.96 | 5.08 |
| **HR 30317 DJ** | 7GB | 113 | 103 | 166 | 144 | 169 | 6 | 16.5 | 3 | 2.5 | 55.4 | 0.83 | 0.73 | 0.40 | 4.88 |
| **HR 31317 J** | 7GB | 113 | 103 | 166 | 144 | 169 | 6 | 16.5 | 3 | 2.5 | 55.4 | 0.83 | 0.73 | 0.40 | 4.88 |
| **HR 32317 J** | 2GD | 110 | 104 | 166 | 151 | 167 | 5 | 14.5 | 3 | 2.5 | 43.6 | 0.35 | 1.7 | 0.96 | 7.31 |
| **HR 32918 J** | 2BC | 101 | 97 | 116 | 116 | 120 | 5 | 5 | 1.5 | 1.5 | 22.0 | 0.34 | 1.8 | 0.96 | 0.838 |
| **HR 32018 XJ** | 3CC | 102 | 99 | 131 | 124 | 134 | 6 | 8 | 2 | 1.5 | 29.7 | 0.42 | 1.4 | 0.78 | 1.78 |
| **HR 33018 J** | 2CE | 102 | 99 | 131 | 129 | 135 | 7 | 6.5 | 2 | 1.5 | 27.9 | 0.27 | 2.2 | 1.2 | 2.21 |
| **HR 33118 J** | 3DE | 105 | 100 | 140 | 132 | 144 | 7 | 10 | 2 | 2 | 35.2 | 0.40 | 1.5 | 0.83 | 3.14 |
| **HR 30218 J** | 3FB | 105 | 103 | 150 | 141 | 150 | 5 | 6.5 | 2 | 2 | 31.7 | 0.42 | 1.4 | 0.79 | 2.6 |
| **HR 32218 J** | 3FC | 105 | 102 | 150 | 139 | 152 | 5 | 8.5 | 2 | 2 | 36.2 | 0.42 | 1.4 | 0.79 | 3.41 |
| **HR 30318 J** | 2GB | 111 | 114 | 176 | 176 | 176 | 5 | 10.5 | 3 | 2.5 | 37.3 | 0.35 | 1.7 | 0.96 | 5.91 |
| **HR 30318 DJ** | 7GB | 118 | 110 | 176 | 152 | 179 | 6 | 16.5 | 3 | 2.5 | 58.7 | 0.83 | 0.73 | 0.40 | 5.52 |
| **HR 31318 J** | 7GB | 118 | 110 | 176 | 152 | 179 | 6 | 16.5 | 3 | 2.5 | 58.7 | 0.83 | 0.73 | 0.40 | 5.52 |
| **HR 32318 J** | 2GD | 115 | 109 | 176 | 158 | 177 | 5 | 14.5 | 3 | 2.5 | 46.5 | 0.35 | 1.7 | 0.96 | 8.6 |
| **HR 32919 J** | 2BC | 106 | 102 | 121 | 121 | 125 | 5 | 5 | 1.5 | 1.5 | 23.2 | 0.36 | 1.7 | 0.92 | 0.877 |
| **HR 32019 XJ** | 4CC | 107 | 104 | 136 | 131 | 140 | 6 | 8 | 2 | 1.5 | 31.2 | 0.44 | 1.4 | 0.75 | 1.88 |
| **HR 33019 J** | 2CE | 107 | 103 | 136 | 133 | 139 | 7 | 6.5 | 2 | 1.5 | 28.6 | 0.28 | 2.2 | 1.2 | 2.3 |
| **T2 ED095** | 2ED | 113 | 108 | 146 | 141 | 152 | 6 | 8 | 2.5 | 2.5 | 34.5 | 0.34 | 1.8 | 0.97 | 3.74 |
| **HR 30219 J** | 3FB | 113 | 110 | 158 | 150 | 159 | 5 | 7.5 | 2.5 | 2 | 33.7 | 0.42 | 1.4 | 0.79 | 3.13 |
| **HR 32219 J** | 3FC | 113 | 108 | 158 | 147 | 161 | 5 | 8.5 | 2.5 | 2 | 39.3 | 0.42 | 1.4 | 0.79 | 4.22 |
| **HR 30319 J** | 2GB | 116 | 119 | 186 | 172 | 184 | 5 | 11.5 | 3 | 2.5 | 38.6 | 0.35 | 1.7 | 0.96 | 6.92 |
| **30319 CA** | — | 116 | 119 | 186 | 168 | 188 | 5 | 13.5 | 3 | 2.5 | 48.6 | 0.54 | 1.1 | 0.61 | 6.71 |
| **HR 30319 DJ** | 7GB | 123 | 115 | 186 | 158 | 187 | 6 | 17.5 | 3 | 2.5 | 61.9 | 0.83 | 0.73 | 0.40 | 6.64 |
| **HR 31319 J** | 7GB | 123 | 115 | 186 | 158 | 187 | 6 | 17.5 | 3 | 2.5 | 61.9 | 0.83 | 0.73 | 0.40 | 6.64 |
| **HR 32319 J** | 2GD | 120 | 115 | 186 | 167 | 186 | 5 | 16.5 | 3 | 2.5 | 48.6 | 0.35 | 1.7 | 0.96 | 10.4 |
| **HR 32920 J** | 2CC | 111 | 109 | 132 | 132 | 134 | 5 | 5 | 1.5 | 1.5 | 24.2 | 0.33 | 1.8 | 1.0 | 1.18 |
| **T4 CB100** | 4CB | 118 | 108 | 135 | 135 | 142 | 6 | 6.5 | 2.5 | 2.5 | 30.1 | 0.47 | 1.3 | 0.70 | 1.18 |
| **HR 32020 XJ** | 4CC | 112 | 109 | 141 | 136 | 144 | 6 | 8 | 2 | 1.5 | 32.5 | 0.46 | 1.3 | 0.72 | 1.95 |
| **HR 33020 J** | 2CE | 112 | 107 | 141 | 137 | 143 | 7 | 6.5 | 2 | 1.5 | 29.3 | 0.29 | 2.1 | 1.2 | 2.38 |
| **HR 33120 J** | 3EE | 115 | 110 | 155 | 144 | 159 | 8 | 12 | 2 | 2 | 40.5 | 0.41 | 1.5 | 0.81 | 4.32 |
| **HR 30220 J** | 3FB | 118 | 116 | 168 | 158 | 168 | 5 | 8 | 2.5 | 2 | 36.1 | 0.42 | 1.4 | 0.79 | 3.78 |
| **HR 32220 J** | 3FC | 118 | 115 | 168 | 155 | 171 | 5 | 10 | 2.5 | 2 | 41.5 | 0.42 | 1.4 | 0.79 | 5.05 |
| **HR 33220 J** | 3FE | 118 | 113 | 168 | 152 | 172 | 10 | 15 | 2.5 | 2 | 46.0 | 0.40 | 1.5 | 0.82 | 6.76 |
| **HR 30320 J** | 2GB | 121 | 128 | 201 | 185 | 197 | 5 | 12.5 | 3 | 2.5 | 41.4 | 0.35 | 1.7 | 0.96 | 8.41 |
| **HR 31320 J** | 7GB | 136 | 125 | 201 | 169 | 202 | 7 | 21.5 | 3 | 2.5 | 67.7 | 0.83 | 0.73 | 0.40 | 9.02 |
| **HR 32320 J** | 2GD | 125 | 125 | 201 | 178 | 200 | 5 | 17.5 | 3 | 2.5 | 53.2 | 0.35 | 1.7 | 0.96 | 12.7 |

## Bore Diameter 105 – 130 mm




| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Limiting Speeds (min$^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cone | Cup | | | | |
| d | D | T | B | C | r min. | | $C_r$ | $C_{0r}$ | Grease | Oil |
| **105** | 145 | 25 | 25 | 20 | 1.5 | 1.5 | 119 000 | 212 000 | 2 200 | 3 000 |
| | 160 | 35 | 35 | 26 | 2.5 | 2 | 204 000 | 340 000 | 2 000 | 2 800 |
| | 160 | 43 | 43 | 34 | 2.5 | 2 | 256 000 | 435 000 | 2 000 | 2 800 |
| | 190 | 39 | 36 | 30 | 3 | 2.5 | 280 000 | 365 000 | 1 900 | 2 600 |
| | 190 | 53 | 50 | 43 | 3 | 2.5 | 360 000 | 510 000 | 1 900 | 2 600 |
| | 225 | 53.5 | 49 | 41 | 4 | 3 | 455 000 | 565 000 | 1 600 | 2 200 |
| | 225 | 58 | 53 | 36 | 4 | 3 | 415 000 | 540 000 | 1 500 | 2 000 |
| | 225 | 81.5 | 77 | 63 | 4 | 3 | 670 000 | 925 000 | 1 700 | 2 200 |
| **110** | 150 | 25 | 25 | 20 | 1.5 | 1.5 | 123 000 | 224 000 | 2 200 | 2 800 |
| | 170 | 38 | 38 | 29 | 2.5 | 2 | 236 000 | 390 000 | 2 000 | 2 600 |
| | 170 | 47 | 47 | 37 | 2.5 | 2 | 294 000 | 515 000 | 2 000 | 2 600 |
| | 180 | 56 | 56 | 43 | 2.5 | 2 | 365 000 | 610 000 | 1 900 | 2 600 |
| | 200 | 41 | 38 | 32 | 3 | 2.5 | 315 000 | 420 000 | 1 800 | 2 400 |
| | 200 | 56 | 53 | 46 | 3 | 2.5 | 400 000 | 565 000 | 1 800 | 2 400 |
| | 240 | 54.5 | 50 | 42 | 4 | 3 | 485 000 | 595 000 | 1 500 | 2 000 |
| | 240 | 63 | 57 | 38 | 4 | 3 | 470 000 | 605 000 | 1 400 | 1 900 |
| | 240 | 84.5 | 80 | 65 | 4 | 3 | 675 000 | 910 000 | 1 500 | 2 000 |
| **120** | 165 | 29 | 29 | 23 | 1.5 | 1.5 | 161 000 | 291 000 | 1 900 | 2 600 |
| | 170 | 27 | 25 | 19.5 | 3 | 3 | 153 000 | 243 000 | 1 800 | 2 600 |
| | 180 | 38 | 38 | 29 | 2.5 | 2 | 242 000 | 405 000 | 1 800 | 2 400 |
| | 180 | 48 | 48 | 38 | 2.5 | 2 | 300 000 | 540 000 | 1 800 | 2 600 |
| | 200 | 62 | 62 | 48 | 2.5 | 2 | 460 000 | 755 000 | 1 700 | 2 400 |
| | 215 | 43.5 | 40 | 34 | 3 | 2.5 | 335 000 | 450 000 | 1 600 | 2 200 |
| | 215 | 61.5 | 58 | 50 | 3 | 2.5 | 440 000 | 635 000 | 1 600 | 2 200 |
| | 260 | 59.5 | 55 | 46 | 4 | 3 | 535 000 | 655 000 | 1 400 | 1 900 |
| | 260 | 68 | 62 | 42 | 4 | 3 | 560 000 | 730 000 | 1 300 | 1 800 |
| | 260 | 90.5 | 86 | 69 | 4 | 3 | 770 000 | 1 060 000 | 1 400 | 1 900 |
| **130** | 180 | 32 | 30 | 26 | 2 | 1.5 | 167 000 | 281 000 | 1 800 | 2 400 |
| | 180 | 32 | 32 | 25 | 2 | 1.5 | 200 000 | 365 000 | 1 800 | 2 400 |
| | 185 | 29 | 27 | 21 | 3 | 3 | 183 000 | 296 000 | 1 700 | 2 400 |
| | 200 | 45 | 45 | 34 | 2.5 | 2 | 320 000 | 535 000 | 1 600 | 2 200 |
| | 200 | 55 | 55 | 43 | 2.5 | 2 | 395 000 | 715 000 | 1 700 | 2 200 |
| | 230 | 43.75 | 40 | 34 | 4 | 3 | 375 000 | 505 000 | 1 500 | 2 000 |
| | 230 | 67.75 | 64 | 54 | 4 | 3 | 530 000 | 790 000 | 1 500 | 2 000 |
| | 280 | 63.75 | 58 | 49 | 5 | 4 | 545 000 | 675 000 | 1 300 | 1 800 |
| | 280 | 63.75 | 58 | 49 | 5 | 4 | 650 000 | 820 000 | 1 300 | 1 800 |
| | 280 | 72 | 66 | 44 | 5 | 4 | 625 000 | 820 000 | 1 200 | 1 700 |
| | 280 | 98.75 | 93 | 78 | 5 | 4 | 830 000 | 1 150 000 | 1 300 | 1 800 |




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | 0 | 0.4 | $Y_1$ |

## Static Equivalent Load

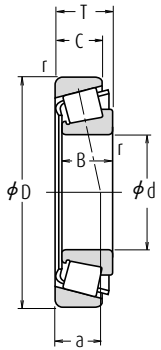
$P_0=0.5F_r+Y_0F_a$

When $F_r>0.5F_r+Y_0F_a$, use $P_0=F_r$

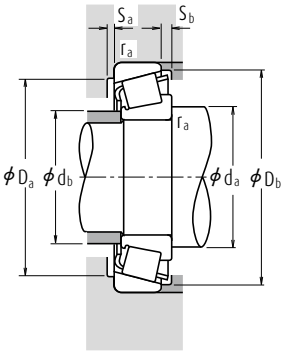
The values of e, $Y_1$ and $Y_0$ are given in the table below.

| Bearing Numbers | ISO355 Dimension Series | Abutment and Fillet Dimensions (mm) | | | | | | | | | Eff. Load Centers (mm) | Constant | Axial Load Factors | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Cone | Cup | | | | | |
| | | $d_a$ | $d_b$ | $D_a$ | | $D_b$ | $S_a$ | $S_b$ | $r_a$ | | | | | | |
| | approx. | min. | max. | max. | min. | min. | min. | min. | max. | | a | e | $Y_1$ | $Y_0$ | approx. |
| **HR 32921 J** | 2CC | 116 | 114 | 137 | 137 | 140 | 5 | 5 | 1.5 | 1.5 | 25.3 | 0.34 | 1.8 | 0.96 | 1.23 |
| **HR 32021 XJ** | 4DC | 120 | 115 | 150 | 144 | 154 | 6 | 9 | 2 | 2 | 34.3 | 0.44 | 1.4 | 0.74 | 2.48 |
| **HR 33021 J** | 2DE | 120 | 115 | 150 | 146 | 153 | 7 | 9 | 2 | 2 | 30.9 | 0.28 | 2.1 | 1.2 | 3.03 |
| **HR 30221 J** | 3FB | 123 | 123 | 178 | 166 | 177 | 6 | 9 | 2.5 | 2 | 38.1 | 0.42 | 1.4 | 0.79 | 4.51 |
| **HR 32221 J** | 3FC | 123 | 120 | 178 | 162 | 180 | 5 | 10 | 2.5 | 2 | 44.8 | 0.42 | 1.4 | 0.79 | 6.25 |
| **HR 30321 J** | 2GB | 126 | 133 | 211 | 195 | 206 | 6 | 12.5 | 3 | 2.5 | 43.3 | 0.35 | 1.7 | 0.96 | 9.52 |
| **HR 31321 J** | 7GB | 141 | 130 | 211 | 177 | 211 | 7 | 22 | 3 | 2.5 | 70.2 | 0.83 | 0.73 | 0.40 | 10 |
| **HR 32321 J** | 2GD | 130 | 129 | 211 | 186 | 209 | 6 | 18.5 | 3 | 2.5 | 55.2 | 0.35 | 1.7 | 0.96 | 14.9 |
| **HR 32922 J** | 2CC | 121 | 119 | 142 | 142 | 145 | 5 | 5 | 1.5 | 1.5 | 26.5 | 0.36 | 1.7 | 0.93 | 1.29 |
| **HR 32022 XJ** | 4DC | 125 | 121 | 160 | 153 | 163 | 7 | 9 | 2 | 2 | 35.9 | 0.43 | 1.4 | 0.77 | 3.09 |
| **HR 33022 J** | 2DE | 125 | 121 | 160 | 153 | 161 | 7 | 10 | 2 | 2 | 33.7 | 0.29 | 2.1 | 1.2 | 3.84 |
| **HR 33122 J** | 3EE | 125 | 121 | 170 | 156 | 174 | 9 | 13 | 2 | 2 | 44.1 | 0.42 | 1.4 | 0.79 | 5.54 |
| **HR 30222 J** | 3FB | 128 | 129 | 188 | 175 | 187 | 6 | 9 | 2.5 | 2 | 40.2 | 0.42 | 1.4 | 0.79 | 5.28 |
| **HR 32222 J** | 3FC | 128 | 127 | 188 | 171 | 190 | 5 | 10 | 2.5 | 2 | 47.2 | 0.42 | 1.4 | 0.79 | 7.35 |
| **HR 30322 J** | 2GB | 131 | 143 | 226 | 208 | 220 | 6 | 12.5 | 3 | 2.5 | 45.1 | 0.35 | 1.7 | 0.96 | 11 |
| **HR 31322 J** | 7GB | 146 | 136 | 226 | 191 | 224 | 7 | 25 | 3 | 2.5 | 74.8 | 0.83 | 0.73 | 0.40 | 12.3 |
| **HR 32322 J** | 2GD | 135 | 139 | 226 | 201 | 222 | 6 | 19.5 | 3 | 2.5 | 58.6 | 0.35 | 1.7 | 0.96 | 17.1 |
| **HR 32924 J** | 2CC | 131 | 129 | 156 | 155 | 160 | 6 | 6 | 1.5 | 1.5 | 29.2 | 0.35 | 1.7 | 0.95 | 1.8 |
| **T4 CB120** | 4CB | 138 | 129 | 158 | 158 | 164 | 7 | 7.5 | 2.5 | 2.5 | 35.0 | 0.47 | 1.3 | 0.70 | 1.78 |
| **HR 32024 XJ** | 4DC | 135 | 131 | 170 | 162 | 173 | 7 | 9 | 2 | 2 | 39.7 | 0.46 | 1.3 | 0.72 | 3.27 |
| **HR 33024 J** | 2DE | 135 | 130 | 168 | 161 | 171 | 6 | 10 | 2 | 2 | 36.0 | 0.31 | 2.0 | 1.1 | 4.2 |
| **HR 33124 J** | 3FE | 135 | 133 | 190 | 173 | 192 | 9 | 14 | 2 | 2 | 47.9 | 0.40 | 1.5 | 0.83 | 7.67 |
| **HR 30224 J** | 4FB | 138 | 141 | 203 | 190 | 201 | 6 | 9.5 | 2.5 | 2 | 44.4 | 0.44 | 1.4 | 0.76 | 6.28 |
| **HR 32224 J** | 4FD | 138 | 137 | 203 | 181 | 204 | 6 | 11.5 | 2.5 | 2 | 52.1 | 0.44 | 1.4 | 0.76 | 9.0 |
| **HR 30324 J** | 2GB | 141 | 154 | 246 | 223 | 237 | 6 | 13.5 | 3 | 2.5 | 50.0 | 0.35 | 1.7 | 0.96 | 13.9 |
| **HR 31324 J** | 7GB | 156 | 148 | 246 | 206 | 244 | 9 | 26 | 3 | 2.5 | 81.7 | 0.83 | 0.73 | 0.40 | 15.6 |
| **HR 32324 J** | 2GD | 145 | 149 | 246 | 216 | 239 | 6 | 21.5 | 3 | 2.5 | 62.5 | 0.35 | 1.7 | 0.96 | 21.8 |
| **32926** | — | 142 | 141 | 171 | 168 | 175 | 6 | 6 | 2 | 1.5 | 34.7 | 0.36 | 1.7 | 0.92 | 2.25 |
| **HR 32926 J** | 2CC | 142 | 140 | 170 | 168 | 173 | 6 | 7 | 2 | 1.5 | 31.4 | 0.34 | 1.8 | 0.97 | 2.46 |
| **T4 CB130** | 4CB | 148 | 141 | 171 | 171 | 179 | 8 | 8 | 2.5 | 2.5 | 37.5 | 0.47 | 1.3 | 0.70 | 2.32 |
| **HR 32026 XJ** | 4EC | 145 | 144 | 190 | 179 | 192 | 8 | 11 | 2 | 2 | 43.9 | 0.43 | 1.4 | 0.76 | 5.06 |
| **HR 33026 J** | 2EE | 145 | 144 | 188 | 179 | 192 | 8 | 12 | 2 | 2 | 42.4 | 0.34 | 1.8 | 0.97 | 6.25 |
| **HR 30226 J** | 4FB | 151 | 151 | 216 | 205 | 217 | 7 | 9.5 | 3 | 2.5 | 45.9 | 0.44 | 1.4 | 0.76 | 7.25 |
| **HR 32226 J** | 4FD | 151 | 147 | 216 | 196 | 219 | 7 | 13.5 | 3 | 2.5 | 57.0 | 0.44 | 1.4 | 0.76 | 11.3 |
| **30326** | — | 157 | 168 | 262 | 239 | 255 | 8 | 14.5 | 4 | 3 | 53.9 | 0.36 | 1.7 | 0.92 | 16.6 |
| **HR 30326 J** | 2GB | 157 | 166 | 262 | 241 | 255 | 8 | 14.5 | 4 | 3 | 52.8 | 0.35 | 1.7 | 0.96 | 17.2 |
| **HR 31326 J** | 7GB | 174 | 159 | 262 | 220 | 261 | 9 | 28 | 4 | 3 | 87.1 | 0.83 | 0.73 | 0.40 | 18.8 |
| **32326** | — | 162 | 165 | 262 | 233 | 263 | 8 | 20.5 | 4 | 3 | 69.2 | 0.36 | 1.7 | 0.92 | 26.6 |

## Bore Diameter 140 – 170 mm




| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Limiting Speeds (min$^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cone | Cup | | | | |
| d | D | T | B | C | r min. | | $C_r$ | $C_{0r}$ | Grease | Oil |
| **140** | 190 | 32 | 32 | 25 | 2 | 1.5 | 206 000 | 390 000 | 1 700 | 2 200 |
| | 210 | 45 | 45 | 34 | 2.5 | 2 | 325 000 | 555 000 | 1 600 | 2 200 |
| | 210 | 56 | 56 | 44 | 2.5 | 2 | 410 000 | 770 000 | 1 600 | 2 200 |
| | 250 | 45.75 | 42 | 36 | 4 | 3 | 390 000 | 515 000 | 1 400 | 1 900 |
| | 250 | 71.75 | 68 | 58 | 4 | 3 | 610 000 | 915 000 | 1 400 | 1 900 |
| | 300 | 67.75 | 62 | 53 | 5 | 4 | 740 000 | 945 000 | 1 200 | 1 700 |
| | 300 | 77 | 70 | 47 | 5 | 4 | 695 000 | 955 000 | 1 100 | 1 500 |
| | 300 | 107.75 | 102 | 85 | 5 | 4 | 985 000 | 1 440 000 | 1 200 | 1 600 |
| **150** | 210 | 38 | 36 | 31 | 2.5 | 2 | 247 000 | 440 000 | 1 500 | 2 000 |
| | 210 | 38 | 38 | 30 | 2.5 | 2 | 281 000 | 520 000 | 1 500 | 2 000 |
| | 225 | 48 | 48 | 36 | 3 | 2.5 | 375 000 | 650 000 | 1 400 | 2 000 |
| | 225 | 59 | 59 | 46 | 3 | 2.5 | 435 000 | 805 000 | 1 400 | 2 000 |
| | 270 | 49 | 45 | 38 | 4 | 3 | 485 000 | 665 000 | 1 300 | 1 800 |
| | 270 | 77 | 73 | 60 | 4 | 3 | 705 000 | 1 080 000 | 1 300 | 1 800 |
| | 320 | 72 | 65 | 55 | 5 | 4 | 690 000 | 860 000 | 1 100 | 1 500 |
| | 320 | 72 | 65 | 55 | 5 | 4 | 825 000 | 1 060 000 | 1 100 | 1 600 |
| | 320 | 82 | 75 | 50 | 5 | 4 | 790 000 | 1 100 000 | 1 000 | 1 400 |
| | 320 | 114 | 108 | 90 | 5 | 4 | 1 120 000 | 1 700 000 | 1 100 | 1 500 |
| **160** | 220 | 38 | 38 | 30 | 2.5 | 2 | 296 000 | 570 000 | 1 400 | 1 900 |
| | 240 | 51 | 51 | 38 | 3 | 2.5 | 425 000 | 750 000 | 1 300 | 1 800 |
| | 290 | 52 | 48 | 40 | 4 | 3 | 530 000 | 730 000 | 1 200 | 1 600 |
| | 290 | 84 | 80 | 67 | 4 | 3 | 795 000 | 1 220 000 | 1 200 | 1 600 |
| | 340 | 75 | 68 | 58 | 5 | 4 | 765 000 | 960 000 | 1 000 | 1 400 |
| | 340 | 75 | 68 | 58 | 5 | 4 | 870 000 | 1 110 000 | 1 100 | 1 400 |
| | 340 | 75 | 68 | 48 | 5 | 4 | 675 000 | 875 000 | 950 | 1 300 |
| | 340 | 121 | 114 | 95 | 5 | 4 | 1 210 000 | 1 770 000 | 1 000 | 1 400 |
| **170** | 230 | 38 | 36 | 31 | 2.5 | 2.5 | 258 000 | 485 000 | 1 300 | 1 800 |
| | 230 | 38 | 38 | 30 | 2.5 | 2 | 294 000 | 560 000 | 1 400 | 1 800 |
| | 260 | 57 | 57 | 43 | 3 | 2.5 | 505 000 | 890 000 | 1 200 | 1 700 |
| | 310 | 57 | 52 | 43 | 5 | 4 | 630 000 | 885 000 | 1 100 | 1 500 |
| | 310 | 91 | 86 | 71 | 5 | 4 | 930 000 | 1 450 000 | 1 100 | 1 500 |
| | 360 | 80 | 72 | 62 | 5 | 4 | 845 000 | 1 080 000 | 950 | 1 300 |
| | 360 | 80 | 72 | 62 | 5 | 4 | 960 000 | 1 230 000 | 1 000 | 1 300 |
| | 360 | 80 | 72 | 50 | 5 | 4 | 760 000 | 1 040 000 | 900 | 1 200 |
| | 360 | 127 | 120 | 100 | 5 | 4 | 1 370 000 | 2 050 000 | 1 000 | 1 300 |




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | 0 | 0.4 | $Y_1$ |

## Static Equivalent Load

$P_0=0.5F_r+Y_0F_a$

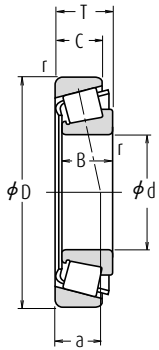
When $F_r>0.5F_r+Y_0F_a$, use $P_0=F_r$

The values of e, $Y_1$ and $Y_0$ are given in the table below.

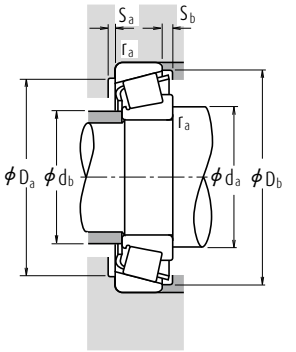
| Bearing Numbers | ISO355 Dimension Series | Abutment and Fillet Dimensions (mm) | | | | | | | | | Eff. Load Centers (mm) | Constant | Axial Load Factors | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Cone | Cup | | | | | |
| | | $d_a$ | $d_b$ | $D_a$ | | $D_b$ | $S_a$ | $S_b$ | $r_a$ | | | | | | |
| | approx. | min. | max. | max. | min. | min. | min. | min. | max. | | a | e | $Y_1$ | $Y_0$ | approx. |
| **HR 32928 J** | 2CC | 152 | 150 | 180 | 178 | 184 | 6 | 7 | 2 | 1.5 | 33.6 | 0.36 | 1.7 | 0.92 | 2.64 |
| **HR 32028 XJ** | 4DC | 155 | 152 | 200 | 189 | 202 | 8 | 11 | 2 | 2 | 46.6 | 0.46 | 1.3 | 0.72 | 5.32 |
| **HR 33028 J** | 2DE | 155 | 153 | 198 | 189 | 202 | 7 | 12 | 2 | 2 | 45.5 | 0.36 | 1.7 | 0.92 | 6.74 |
| **HR 30228 J** | 4FB | 161 | 164 | 236 | 221 | 234 | 7 | 9.5 | 3 | 2.5 | 48.9 | 0.44 | 1.4 | 0.76 | 8.74 |
| **HR 32228 J** | 4FD | 161 | 159 | 236 | 213 | 238 | 9 | 13.5 | 3 | 2.5 | 60.5 | 0.44 | 1.4 | 0.76 | 14.3 |
| **HR 30328 J** | 2GB | 167 | 177 | 282 | 256 | 273 | 9 | 14.5 | 4 | 3 | 55.7 | 0.35 | 1.7 | 0.96 | 21.1 |
| **HR 31328 J** | 7GB | 184 | 174 | 282 | 236 | 280 | 9 | 30 | 4 | 3 | 92.9 | 0.83 | 0.73 | 0.40 | 28.5 |
| **32328** | — | 172 | 177 | 282 | 246 | 281 | 9 | 22.5 | 4 | 3 | 76.4 | 0.37 | 1.6 | 0.88 | 33.9 |
| **32930** | — | 165 | 162 | 200 | 195 | 201 | 7 | 7 | 2 | 2 | 36.7 | 0.33 | 1.8 | 1.0 | 3.8 |
| **HR 32930 J** | 2DC | 165 | 163 | 198 | 196 | 202 | 7 | 8 | 2 | 2 | 36.5 | 0.33 | 1.8 | 1.0 | 4.05 |
| **HR 32030 XJ** | 4EC | 168 | 164 | 213 | 202 | 216 | 8 | 12 | 2.5 | 2 | 49.8 | 0.46 | 1.3 | 0.72 | 6.6 |
| **HR 33030 J** | 2EE | 168 | 165 | 213 | 203 | 217 | 8 | 13 | 2.5 | 2 | 48.7 | 0.36 | 1.7 | 0.90 | 8.07 |
| **HR 30230 J** | 2GB | 171 | 175 | 256 | 236 | 250 | 7 | 11 | 3 | 2.5 | 51.3 | 0.44 | 1.4 | 0.76 | 11.2 |
| **HR 32230 J** | 4GD | 171 | 171 | 256 | 228 | 254 | 8 | 17 | 3 | 2.5 | 64.7 | 0.44 | 1.4 | 0.76 | 17.8 |
| **30330** | — | 177 | 193 | 302 | 275 | 292 | 8 | 17 | 4 | 3 | 61.4 | 0.36 | 1.7 | 0.92 | 24.2 |
| **HR 30330 J** | 2GB | 177 | 190 | 302 | 276 | 292 | 8 | 17 | 4 | 3 | 60.0 | 0.35 | 1.7 | 0.96 | 25 |
| **HR 31330 J** | 7GB | 194 | 187 | 302 | 253 | 300 | 9 | 32 | 4 | 3 | 99.3 | 0.83 | 0.73 | 0.40 | 28.5 |
| **32330** | — | 182 | 191 | 302 | 262 | 297 | 8 | 24 | 4 | 3 | 81.5 | 0.37 | 1.6 | 0.88 | 41.4 |
| **HR 32932 J** | 2DC | 175 | 173 | 208 | 206 | 212 | 7 | 8 | 2 | 2 | 38.7 | 0.35 | 1.7 | 0.95 | 4.32 |
| **HR 32032 XJ** | 4EC | 178 | 175 | 228 | 216 | 231 | 8 | 13 | 2.5 | 2 | 53.0 | 0.46 | 1.3 | 0.72 | 7.93 |
| **HR 30232 J** | 4GB | 181 | 189 | 276 | 253 | 269 | 8 | 12 | 3 | 2.5 | 55.0 | 0.44 | 1.4 | 0.76 | 13.7 |
| **HR 32232 J** | 4GD | 181 | 184 | 276 | 243 | 274 | 10 | 17 | 3 | 2.5 | 70.5 | 0.44 | 1.4 | 0.76 | 22.7 |
| **30332** | — | 187 | 205 | 322 | 293 | 311 | 10 | 17 | 4 | 3 | 64.6 | 0.36 | 1.7 | 0.92 | 28.4 |
| **HR 30332 J** | 2GB | 187 | 201 | 322 | 293 | 310 | 10 | 17 | 4 | 3 | 62.9 | 0.35 | 1.7 | 0.96 | 29.2 |
| **30332 D** | — | 196 | 198 | 322 | 270 | 313 | 9 | 27 | 4 | 3 | 99.4 | 0.81 | 0.74 | 0.41 | 27.5 |
| **32332** | — | 192 | 202 | 322 | 281 | 319 | 10 | 26 | 4 | 3 | 87.1 | 0.37 | 1.6 | 0.88 | 48.3 |
| **32934** | — | 185 | 183 | 220 | 216 | 223 | 7 | 7 | 2 | 2 | 41.6 | 0.36 | 1.7 | 0.90 | 4.3 |
| **HR 32934 J** | 3DC | 185 | 180 | 218 | 215 | 222 | 7 | 8 | 2 | 2 | 41.7 | 0.38 | 1.6 | 0.86 | 4.44 |
| **HR 32034 XJ** | 4EC | 188 | 187 | 248 | 232 | 249 | 10 | 14 | 2.5 | 2 | 56.6 | 0.44 | 1.4 | 0.74 | 10.6 |
| **HR 30234 J** | 4GB | 197 | 202 | 292 | 273 | 288 | 8 | 14 | 4 | 3 | 59.4 | 0.44 | 1.4 | 0.76 | 17.1 |
| **HR 32234 J** | 4GD | 197 | 197 | 292 | 262 | 294 | 10 | 20 | 4 | 3 | 76.4 | 0.44 | 1.4 | 0.76 | 28 |
| **30334** | — | 197 | 221 | 342 | 312 | 332 | 10 | 18 | 4 | 3 | 70.1 | 0.37 | 1.6 | 0.90 | 33.5 |
| **HR 30334 J** | 2GB | 197 | 214 | 342 | 310 | 329 | 10 | 18 | 4 | 3 | 67.3 | 0.35 | 1.7 | 0.96 | 34.5 |
| **30334 D** | — | 206 | 215 | 342 | 288 | 332 | 10 | 30 | 4 | 3 | 107.3 | 0.81 | 0.74 | 0.41 | 33.4 |
| **32334** | — | 202 | 213 | 342 | 297 | 337 | 10 | 27 | 4 | 3 | 91.3 | 0.37 | 1.6 | 0.88 | 57 |

# Single-Row Tapered Roller Bearings

## Bore Diameter 180 – 240 mm




| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Limiting Speeds ($min^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cone | Cup | | | | |
| d | D | T | B | C | r min. | | $C_r$ | $C_{0r}$ | Grease | Oil |
| **180** | 250 | 45 | 45 | 34 | 2,5 | 2 | 350 000 | 685 000 | 1 300 | 1 700 |
| | 280 | 64 | 64 | 48 | 3 | 2,5 | 640 000 | 1 130 000 | 1 200 | 1 600 |
| | 320 | 57 | 52 | 43 | 5 | 4 | 650 000 | 930 000 | 1 100 | 1 400 |
| | 320 | 91 | 86 | 71 | 5 | 4 | 960 000 | 1 540 000 | 1 100 | 1 400 |
| | 380 | 83 | 75 | 64 | 5 | 4 | 935 000 | 1 230 000 | 900 | 1 300 |
| | 380 | 83 | 75 | 53 | 5 | 4 | 820 000 | 1 120 000 | 850 | 1 200 |
| | 380 | 134 | 126 | 106 | 5 | 4 | 1 520 000 | 2 290 000 | 950 | 1 300 |
| **190** | 260 | 45 | 45 | 34 | 2,5 | 2 | 365 000 | 715 000 | 1 200 | 1 600 |
| | 290 | 64 | 64 | 48 | 3 | 2,5 | 650 000 | 1 170 000 | 1 100 | 1 500 |
| | 340 | 60 | 55 | 46 | 5 | 4 | 715 000 | 1 020 000 | 1 000 | 1 300 |
| | 340 | 97 | 92 | 75 | 5 | 4 | 1 110 000 | 1 770 000 | 1 000 | 1 400 |
| | 400 | 86 | 78 | 65 | 6 | 5 | 1 010 000 | 1 340 000 | 850 | 1 200 |
| | 400 | 140 | 132 | 109 | 6 | 5 | 1 660 000 | 2 580 000 | 850 | 1 200 |
| **200** | 280 | 51 | 48 | 41 | 3 | 2,5 | 410 000 | 780 000 | 1 100 | 1 500 |
| | 280 | 51 | 51 | 39 | 3 | 2,5 | 480 000 | 935 000 | 1 100 | 1 500 |
| | 310 | 70 | 70 | 53 | 3 | 2,5 | 760 000 | 1 370 000 | 1 000 | 1 400 |
| | 360 | 64 | 58 | 48 | 5 | 4 | 795 000 | 1 120 000 | 950 | 1 300 |
| | 360 | 104 | 98 | 82 | 5 | 4 | 1 210 000 | 1 920 000 | 950 | 1 300 |
| | 420 | 89 | 80 | 67 | 6 | 5 | 1 030 000 | 1 390 000 | 850 | 1 200 |
| | 420 | 89 | 80 | 56 | 6 | 5 | 965 000 | 1 330 000 | 750 | 1 000 |
| | 420 | 146 | 138 | 115 | 6 | 5 | 1 820 000 | 2 870 000 | 800 | 1 100 |
| **220** | 300 | 51 | 51 | 39 | 3 | 2,5 | 490 000 | 990 000 | 1 000 | 1 400 |
| | 340 | 76 | 76 | 57 | 4 | 3 | 885 000 | 1 610 000 | 950 | 1 300 |
| | 400 | 72 | 65 | 54 | 5 | 4 | 810 000 | 1 150 000 | 850 | 1 100 |
| | 400 | 114 | 108 | 90 | 5 | 4 | 1 340 000 | 2 210 000 | 850 | 1 100 |
| | 460 | 97 | 88 | 73 | 6 | 5 | 1 430 000 | 1 990 000 | 750 | 1 000 |
| | 460 | 154 | 145 | 122 | 6 | 5 | 2 020 000 | 3 200 000 | 750 | 1 000 |
| **240** | 320 | 51 | 51 | 39 | 3 | 2,5 | 500 000 | 1 040 000 | 950 | 1 300 |
| | 360 | 76 | 76 | 57 | 4 | 3 | 920 000 | 1 730 000 | 850 | 1 200 |
| | 440 | 79 | 72 | 60 | 5 | 4 | 990 000 | 1 400 000 | 750 | 1 000 |
| | 440 | 127 | 120 | 100 | 5 | 4 | 1 630 000 | 2 730 000 | 750 | 1 000 |
| | 500 | 105 | 95 | 80 | 6 | 5 | 1 660 000 | 2 340 000 | 670 | 950 |
| | 500 | 165 | 155 | 132 | 6 | 5 | 2 520 000 | 4 100 000 | 670 | 900 |




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | 0 | 0.4 | $Y_1$ |

## Static Equivalent Load

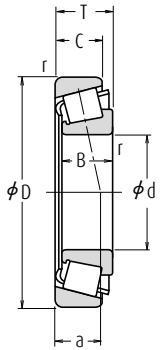
$P_0=0.5F_r+Y_0F_a$

When $F_r>0.5F_r+Y_0F_a$, use $P_0=F_r$

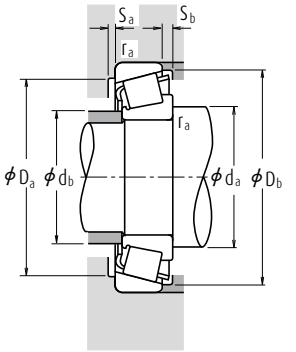
The values of e, $Y_1$ and $Y_0$ are given in the table below.

| Bearing Numbers | ISO355 Dimension Series | Abutment and Fillet Dimensions (mm) | | | | | | | | | Eff. Load Centers (mm) | Constant | Axial Load Factors | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Cone | Cup | | | | | |
| | approx. | $d_a$ min. | $d_b$ max. | $D_a$ max. | $D_a$ min. | $D_b$ min. | $S_a$ min. | $S_b$ min. | $r_a$ max. | | a | e | $Y_1$ | $Y_0$ | approx. |
| **HR 32936 J** | 4DC | 195 | 192 | 240 | 227 | 241 | 8 | 11 | 2 | 2 | 53.9 | 0.48 | 1.3 | 0.69 | 6.56 |
| **HR 32036 XJ** | 3FD | 198 | 199 | 268 | 248 | 267 | 10 | 16 | 2.5 | 2 | 60.4 | 0.42 | 1.4 | 0.78 | 14.3 |
| **HR 30236 J** | 4GB | 207 | 210 | 302 | 281 | 297 | 9 | 14 | 4 | 3 | 61.8 | 0.45 | 1.3 | 0.73 | 17.8 |
| **HR 32236 J** | 4GD | 207 | 205 | 302 | 270 | 303 | 10 | 20 | 4 | 3 | 78.9 | 0.45 | 1.3 | 0.73 | 29.8 |
| **30336** | – | 207 | 233 | 362 | 324 | 345 | 10 | 19 | 4 | 3 | 72.5 | 0.36 | 1.7 | 0.92 | 39.3 |
| **30336 D** | – | 216 | 229 | 362 | 304 | 352 | 10 | 30 | 4 | 3 | 113.1 | 0.81 | 0.74 | 0.41 | 38.5 |
| **32336** | – | 212 | 225 | 362 | 310 | 353 | 10 | 28 | 4 | 3 | 96.6 | 0.37 | 1.6 | 0.88 | 66.8 |
| **HR 32938 J** | 4DC | 205 | 201 | 250 | 237 | 251 | 8 | 11 | 2 | 2 | 55.3 | 0.48 | 1.3 | 0.69 | 6.83 |
| **HR 32038 XJ** | 4FD | 208 | 209 | 278 | 258 | 279 | 10 | 16 | 2.5 | 2 | 63.4 | 0.44 | 1.4 | 0.75 | 14.9 |
| **HR 30238 J** | 4GB | 217 | 223 | 322 | 302 | 318 | 9 | 14 | 4 | 3 | 65.6 | 0.44 | 1.4 | 0.76 | 21.4 |
| **HR 32238 J** | 4GD | 217 | 216 | 322 | 290 | 323 | 10 | 22 | 4 | 3 | 80.5 | 0.44 | 1.4 | 0.76 | 35.2 |
| **30338** | – | 223 | 248 | 378 | 346 | 366 | 11 | 21 | 5 | 4 | 76.1 | 0.36 | 1.7 | 0.92 | 46 |
| **32338** | – | 229 | 243 | 378 | 332 | 375 | 11 | 31 | 5 | 4 | 102.7 | 0.37 | 1.6 | 0.88 | 78.9 |
| **32940** | – | 218 | 217 | 268 | 256 | 269 | 9 | 10 | 2.5 | 2 | 53.4 | 0.37 | 1.6 | 0.88 | 9.26 |
| **HR 32940 J** | 3EC | 218 | 216 | 268 | 258 | 271 | 9 | 12 | 2.5 | 2 | 54.2 | 0.39 | 1.5 | 0.84 | 9.65 |
| **HR 32040 XJ** | 4FD | 218 | 221 | 298 | 277 | 297 | 11 | 17 | 2.5 | 2 | 67.4 | 0.43 | 1.4 | 0.77 | 18.9 |
| **HR 30240 J** | 4GB | 227 | 236 | 342 | 318 | 336 | 10 | 16 | 4 | 3 | 69.1 | 0.44 | 1.4 | 0.76 | 25.5 |
| **HR 32240 J** | 3GD | 227 | 230 | 342 | 305 | 340 | 11 | 22 | 4 | 3 | 85.1 | 0.41 | 1.5 | 0.81 | 42.6 |
| **30340** | – | 233 | 253 | 398 | 346 | 368 | 11 | 22 | 5 | 4 | 81.4 | 0.37 | 1.6 | 0.88 | 52.3 |
| **30340 D** | – | 244 | 253 | 398 | 336 | 385 | 11 | 33 | 5 | 4 | 122.9 | 0.81 | 0.74 | 0.41 | 49.6 |
| **32340** | – | 239 | 253 | 398 | 346 | 392 | 11 | 31 | 5 | 4 | 106.7 | 0.37 | 1.6 | 0.88 | 90.9 |
| **HR 32944 J** | 3EC | 238 | 235 | 288 | 278 | 293 | 9 | 12 | 2.5 | 2 | 59.2 | 0.43 | 1.4 | 0.78 | 10.3 |
| **HR 32044 XJ** | 4FD | 241 | 244 | 326 | 303 | 326 | 12 | 19 | 3 | 2.5 | 73.6 | 0.43 | 1.4 | 0.77 | 24.4 |
| **30244** | – | 247 | 267 | 382 | 350 | 367 | 11 | 18 | 4 | 3 | 74.7 | 0.40 | 1.5 | 0.82 | 33.6 |
| **32244** | – | 247 | 260 | 382 | 340 | 377 | 12 | 24 | 4 | 3 | 93.0 | 0.40 | 1.5 | 0.82 | 57.4 |
| **30344** | – | 253 | 283 | 438 | 390 | 414 | 12 | 24 | 5 | 4 | 85.4 | 0.36 | 1.7 | 0.92 | 72.4 |
| **32344** | – | 259 | 274 | 438 | 372 | 421 | 12 | 32 | 5 | 4 | 114.9 | 0.37 | 1.6 | 0.88 | 114 |
| **HR 32948 J** | 4EC | 258 | 255 | 308 | 297 | 314 | 9 | 12 | 2.5 | 2 | 65.1 | 0.46 | 1.3 | 0.72 | 11.1 |
| **HR 32048 XJ** | 4FD | 261 | 262 | 346 | 321 | 346 | 12 | 19 | 3 | 2.5 | 79.1 | 0.46 | 1.3 | 0.72 | 26.2 |
| **30248** | – | 267 | 288 | 422 | 384 | 408 | 11 | 19 | 4 | 3 | 85.1 | 0.44 | 1.4 | 0.74 | 45.2 |
| **32248** | – | 267 | 285 | 422 | 374 | 416 | 12 | 27 | 4 | 3 | 102.5 | 0.40 | 1.5 | 0.82 | 78 |
| **30348** | – | 273 | 308 | 478 | 422 | 447 | 12 | 25 | 5 | 4 | 92.8 | 0.36 | 1.7 | 0.92 | 92.6 |
| **32348** | – | 279 | 301 | 478 | 410 | 464 | 12 | 33 | 5 | 4 | 123.2 | 0.37 | 1.6 | 0.88 | 145 |

## Bore Diameter 260 – 440 mm




| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Limiting Speeds ($min^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cone | Cup | | | | |
| d | D | T | B | C | r min. | | $C_r$ | $C_{0r}$ | Grease | Oil |
| **260** | 360 | 63.5 | 63.5 | 48 | 3 | 2.5 | 730 000 | 1 450 000 | 850 | 1 100 |
| | 400 | 87 | 87 | 65 | 5 | 4 | 1 160 000 | 2 160 000 | 800 | 1 100 |
| | 480 | 89 | 80 | 67 | 6 | 5 | 1 190 000 | 1 700 000 | 670 | 900 |
| | 480 | 137 | 130 | 106 | 6 | 5 | 1 900 000 | 3 300 000 | 670 | 950 |
| | 540 | 113 | 102 | 85 | 6 | 6 | 1 870 000 | 2 640 000 | 630 | 850 |
| | 540 | 176 | 165 | 136 | 6 | 6 | 2 910 000 | 4 800 000 | 630 | 850 |
| **280** | 380 | 63.5 | 63.5 | 48 | 3 | 2.5 | 765 000 | 1 580 000 | 800 | 1 100 |
| | 420 | 87 | 87 | 65 | 5 | 4 | 1 180 000 | 2 240 000 | 710 | 1 000 |
| | 500 | 89 | 80 | 67 | 6 | 5 | 1 240 000 | 1 900 000 | 630 | 850 |
| | 500 | 137 | 130 | 106 | 6 | 5 | 1 950 000 | 3 450 000 | 630 | 850 |
| | 580 | 187 | 175 | 145 | 6 | 6 | 3 300 000 | 5 400 000 | 560 | 800 |
| **300** | 420 | 76 | 72 | 62 | 4 | 3 | 895 000 | 1 820 000 | 710 | 950 |
| | 420 | 76 | 76 | 57 | 4 | 3 | 1 010 000 | 2 100 000 | 710 | 950 |
| | 460 | 100 | 100 | 74 | 5 | 4 | 1 440 000 | 2 700 000 | 670 | 900 |
| | 540 | 96 | 85 | 71 | 6 | 5 | 1 440 000 | 2 100 000 | 600 | 800 |
| | 540 | 149 | 140 | 115 | 6 | 5 | 2 220 000 | 3 700 000 | 600 | 800 |
| **320** | 440 | 76 | 72 | 63 | 4 | 3 | 900 000 | 1 880 000 | 970 | 900 |
| | 440 | 76 | 76 | 57 | 4 | 3 | 1 040 000 | 2 220 000 | 670 | 900 |
| | 480 | 100 | 100 | 74 | 5 | 4 | 1 510 000 | 2 910 000 | 630 | 850 |
| | 580 | 104 | 92 | 75 | 6 | 5 | 1 640 000 | 2 420 000 | 530 | 750 |
| | 580 | 159 | 150 | 125 | 6 | 5 | 2 860 000 | 5 050 000 | 530 | 750 |
| | 670 | 210 | 200 | 170 | 7.5 | 7.5 | 4 200 000 | 7 100 000 | 480 | 670 |
| **340** | 460 | 76 | 72 | 63 | 4 | 3 | 910 000 | 1 940 000 | 630 | 850 |
| | 460 | 76 | 76 | 57 | 4 | 3 | 1 050 000 | 2 220 000 | 630 | 850 |
| | 520 | 112 | 106 | 92 | 6 | 5 | 1 650 000 | 3 400 000 | 560 | 750 |
| **360** | 480 | 76 | 72 | 62 | 4 | 3 | 945 000 | 2 100 000 | 600 | 800 |
| | 480 | 76 | 76 | 57 | 4 | 3 | 1 080 000 | 2 340 000 | 560 | 800 |
| | 540 | 112 | 106 | 92 | 6 | 5 | 1 680 000 | 3 500 000 | 530 | 750 |
| **380** | 520 | 87 | 82 | 71 | 5 | 4 | 1 210 000 | 2 550 000 | 560 | 750 |
| **400** | 540 | 87 | 82 | 71 | 5 | 4 | 1 250 000 | 2 700 000 | 530 | 710 |
| | 600 | 125 | 118 | 100 | 6 | 5 | 1 960 000 | 4 050 000 | 480 | 670 |
| **420** | 560 | 87 | 82 | 72 | 5 | 4 | 1 300 000 | 2 810 000 | 500 | 670 |
| | 620 | 125 | 118 | 100 | 6 | 5 | 2 000 000 | 4 200 000 | 450 | 630 |
| **440** | 650 | 130 | 122 | 104 | 6 | 6 | 2 230 000 | 4 600 000 | 430 | 600 |




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | 0 | 0.4 | $Y_1$ |

## Static Equivalent Load

$P_0=0.5F_r+Y_0F_a$

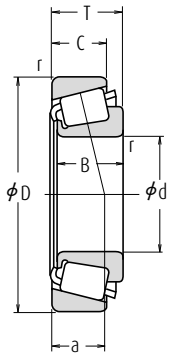
When $F_r>0.5F_r+Y_0F_a$, use $P_0=F_r$

The values of e, $Y_1$ and $Y_0$ are given in the table below.

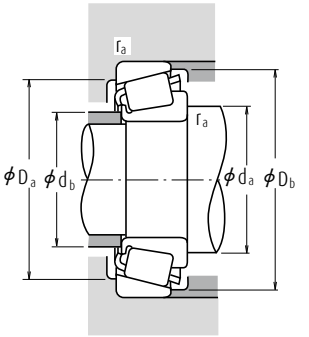
| Bearing Numbers | ISO355 Dimension Series | Abutment and Fillet Dimensions (mm) | | | | | | | | | Eff. Load Centers (mm) | Constant | Axial Load Factors | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Cone | Cup | | | | | |
| | | $d_a$ | $d_b$ | $D_a$ | | $D_b$ | $S_a$ | $S_b$ | $r_a$ | | | | | | |
| | approx. | min. | max. | max. | min. | min. | min. | min. | max. | | a | e | $Y_1$ | $Y_0$ | approx. |
| **HR 32952 J** | 3EC | 278 | 278 | 348 | 333 | 347 | 11 | 15.5 | 2.5 | 2 | 69.8 | 0.41 | 1.5 | 0.81 | 18.6 |
| **HR 32052 XJ** | 4FC | 287 | 287 | 382 | 357 | 383 | 14 | 22 | 4 | 3 | 86.3 | 0.43 | 1.4 | 0.76 | 38.5 |
| **30252** | — | 293 | 316 | 458 | 421 | 447 | 12 | 22 | 5 | 4 | 94.6 | 0.44 | 1.4 | 0.74 | 60.7 |
| **32252** | — | 293 | 305 | 458 | 394 | 446 | 14 | 31 | 5 | 4 | 116.0 | 0.45 | 1.3 | 0.73 | 103 |
| **30352** | — | 293 | 336 | 512 | 460 | 487 | 16 | 28 | 5 | 5 | 101.6 | 0.36 | 1.7 | 0.92 | 114 |
| **32352** | — | 293 | 328 | 512 | 441 | 495 | 13 | 40 | 5 | 5 | 130.5 | 0.37 | 1.6 | 0.88 | 188 |
| **HR 32956 J** | 4EC | 298 | 297 | 368 | 352 | 368 | 12 | 15.5 | 2.5 | 2 | 75.3 | 0.43 | 1.4 | 0.76 | 20 |
| **HR 32056 XJ** | 4FC | 307 | 305 | 402 | 374 | 402 | 14 | 22 | 4 | 3 | 91.6 | 0.46 | 1.3 | 0.72 | 40.6 |
| **30256** | — | 313 | 339 | 478 | 436 | 462 | 12 | 22 | 5 | 4 | 98.5 | 0.44 | 1.4 | 0.74 | 66.3 |
| **32256** | — | 313 | 325 | 478 | 412 | 467 | 14 | 31 | 5 | 4 | 123.1 | 0.47 | 1.3 | 0.70 | 109 |
| **32356** | — | 319 | 353 | 552 | 475 | 532 | 14 | 42 | 5 | 5 | 139.6 | 0.37 | 1.6 | 0.89 | 224 |
| **32960** | — | 321 | 326 | 406 | 386 | 405 | 13 | 14 | 3 | 2.5 | 79.3 | 0.37 | 1.6 | 0.88 | 30.5 |
| **HR 32960 J** | 3FD | 321 | 324 | 406 | 387 | 405 | 13 | 19 | 3 | 2.5 | 79.9 | 0.39 | 1.5 | 0.84 | 31.4 |
| **HR 32060 XJ** | 4GD | 327 | 330 | 442 | 408 | 439 | 15 | 26 | 4 | 3 | 98.4 | 0.43 | 1.4 | 0.76 | 56.6 |
| **30260** | — | 333 | 355 | 518 | 470 | 499 | 14 | 25 | 5 | 4 | 105.1 | 0.44 | 1.4 | 0.74 | 80.6 |
| **32260** | — | 333 | 352 | 518 | 458 | 514 | 15 | 34 | 5 | 4 | 131.7 | 0.46 | 1.3 | 0.72 | 132 |
| **32964** | — | 341 | 345 | 426 | 404 | 425 | 13 | 13 | 3 | 2.5 | 84.3 | 0.39 | 1.5 | 0.84 | 32 |
| **HR 32964 J** | 3FD | 341 | 344 | 426 | 406 | 426 | 13 | 19 | 3 | 2.5 | 85.0 | 0.42 | 1.4 | 0.79 | 33.3 |
| **HR 32064 XJ** | 4GD | 347 | 350 | 462 | 430 | 461 | 15 | 26 | 4 | 3 | 104.5 | 0.46 | 1.3 | 0.72 | 60 |
| **30264** | — | 353 | 381 | 558 | 503 | 533 | 14 | 29 | 5 | 4 | 113.7 | 0.44 | 1.4 | 0.74 | 99.3 |
| **32264** | — | 353 | 383 | 558 | 487 | 550 | 15 | 34 | 5 | 4 | 141.7 | 0.46 | 1.3 | 0.72 | 175 |
| **32364** | — | 383 | 412 | 634 | 547 | 616 | 14 | 42 | 6 | 6 | 157.5 | 0.37 | 1.6 | 0.88 | 343 |
| **32968** | — | 361 | 364 | 446 | 426 | 446 | 13 | 13 | 3 | 2.5 | 89.2 | 0.41 | 1.5 | 0.80 | 33.6 |
| **HR 32968 J** | 4FD | 361 | 362 | 446 | 427 | 446 | 13 | 19 | 3 | 2.5 | 91.0 | 0.44 | 1.4 | 0.75 | 34.3 |
| **32068** | — | 373 | 386 | 498 | 464 | 496 | 3.5 | 22 | 5 | 4 | 104.5 | 0.37 | 1.6 | 0.89 | 83.7 |
| **32972** | — | 381 | 386 | 466 | 445 | 465 | 14 | 14 | 3 | 2.5 | 91.4 | 0.40 | 1.5 | 0.82 | 35.8 |
| **HR 32972 J** | 4FD | 381 | 381 | 466 | 445 | 466 | 13 | 19 | 3 | 2.5 | 96.8 | 0.46 | 1.3 | 0.72 | 36.1 |
| **32072** | — | 393 | 402 | 518 | 480 | 514 | 5.5 | 22 | 5 | 4 | 108.6 | 0.38 | 1.6 | 0.86 | 86.5 |
| **32976** | — | 407 | 406 | 502 | 478 | 501 | 16 | 16 | 4 | 3 | 95.2 | 0.39 | 1.6 | 0.86 | 49.5 |
| **32980** | — | 427 | 428 | 522 | 499 | 524 | 16 | 16 | 4 | 3 | 100.8 | 0.40 | 1.5 | 0.82 | 52.7 |
| **32080** | — | 433 | 443 | 578 | 533 | 565 | 5 | 25 | 5 | 4 | 115.3 | 0.36 | 1.7 | 0.92 | 116 |
| **32984** | — | 447 | 448 | 542 | 521 | 544 | 3.5 | 15 | 4 | 3 | 106.1 | 0.41 | 1.5 | 0.81 | 54.8 |
| **32084** | — | 453 | 463 | 598 | 552 | 586 | 6.5 | 25 | 5 | 4 | 120.0 | 0.37 | 1.6 | 0.88 | 121 |
| **32088** | — | 473 | 487 | 622 | 582 | 616 | 5 | 26 | 5 | 5 | 126.3 | 0.36 | 1.7 | 0.92 | 136 |

# Single-Row Tapered Roller Bearings (Inch Design)

## Bore Diameter 12.000 – 22.225 mm




| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Limiting Speeds ($min^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cone | Cup | | | | |
| d | D | T | B | C | r min. | | $C_r$ | $C_{0r}$ | Grease | Oil |
| **12.000** | 31.991 | 10.008 | 10.785 | 7.938 | 0.8 | 1.3 | 10 300 | 8 900 | 13 000 | 18 000 |
| **12.700** | 34.988 | 10.998 | 10.988 | 8.730 | 1.3 | 1.3 | 11 700 | 10 900 | 12 000 | 16 000 |
| **15.000** | 34.988 | 10.998 | 10.988 | 8.730 | 0.8 | 1.3 | 11 700 | 10 900 | 12 000 | 16 000 |
| **15.875** | 34.988 | 10.998 | 10.998 | 8.712 | 1.3 | 1.3 | 13 800 | 13 400 | 11 000 | 15 000 |
| | 39.992 | 12.014 | 11.153 | 9.525 | 1.3 | 1.3 | 14 900 | 15 700 | 9 500 | 13 000 |
| | 41.275 | 14.288 | 14.681 | 11.112 | 1.3 | 2.0 | 21 300 | 19 900 | 10 000 | 13 000 |
| | 42.862 | 14.288 | 14.288 | 9.525 | 1.5 | 1.5 | 17 300 | 17 200 | 8 500 | 12 000 |
| | 42.862 | 16.670 | 16.670 | 13.495 | 1.5 | 1.5 | 26 900 | 26 300 | 9 500 | 13 000 |
| | 44.450 | 15.494 | 14.381 | 11.430 | 1.5 | 1.5 | 23 800 | 23 900 | 8 500 | 11 000 |
| | 49.225 | 19.845 | 21.539 | 14.288 | 0.8 | 1.3 | 37 500 | 37 000 | 8 500 | 11 000 |
| **16.000** | 47.000 | 21.000 | 21.000 | 16.000 | 1.0 | 2.0 | 35 000 | 36 500 | 9 000 | 12 000 |
| **16.993** | 39.992 | 12.014 | 11.153 | 9.525 | 0.8 | 1.3 | 14 900 | 15 700 | 9 500 | 13 000 |
| **17.455** | 36.525 | 11.112 | 11.112 | 7.938 | 1.5 | 1.5 | 11 600 | 11 000 | 10 000 | 14 000 |
| **17.462** | 39.878 | 13.843 | 14.605 | 10.668 | 1.3 | 1.3 | 22 500 | 22 500 | 10 000 | 13 000 |
| | 47.000 | 14.381 | 14.381 | 11.112 | 0.8 | 1.3 | 23 800 | 23 900 | 8 500 | 11 000 |
| **19.050** | 39.992 | 12.014 | 11.153 | 9.525 | 1.0 | 1.3 | 14 900 | 15 700 | 9 500 | 13 000 |
| | 45.237 | 15.494 | 16.637 | 12.065 | 1.3 | 1.3 | 28 500 | 28 900 | 9 000 | 12 000 |
| | 47.000 | 14.381 | 14.381 | 11.112 | 1.3 | 1.3 | 23 800 | 23 900 | 8 500 | 11 000 |
| | 49.225 | 18.034 | 19.050 | 14.288 | 1.3 | 1.3 | 37 500 | 37 000 | 8 500 | 11 000 |
| | 49.225 | 19.845 | 21.539 | 14.288 | 1.2 | 1.3 | 37 500 | 37 000 | 8 500 | 11 000 |
| | 49.225 | 21.209 | 19.050 | 17.462 | 1.3 | 1.5 | 37 500 | 37 000 | 8 500 | 11 000 |
| | 49.225 | 23.020 | 21.539 | 17.462 | C1.5 | 3.5 | 37 500 | 37 000 | 8 500 | 11 000 |
| | 53.975 | 22.225 | 21.839 | 15.875 | 1.5 | 2.3 | 40 500 | 39 500 | 7 500 | 10 000 |
| **19.990** | 47.000 | 14.381 | 14.381 | 11.112 | 1.5 | 1.3 | 23 800 | 23 900 | 8 500 | 11 000 |
| **20.000** | 51.994 | 15.011 | 14.260 | 12.700 | 1.5 | 1.3 | 26 000 | 27 900 | 7 500 | 10 000 |
| **20.625** | 49.225 | 23.020 | 21.539 | 17.462 | 1.5 | 1.5 | 37 500 | 37 000 | 8 500 | 11 000 |
| **20.638** | 49.225 | 19.845 | 19.845 | 15.875 | 1.5 | 1.5 | 36 000 | 37 000 | 8 000 | 11 000 |
| **21.430** | 50.005 | 17.526 | 18.288 | 13.970 | 1.3 | 1.3 | 38 500 | 40 000 | 8 000 | 11 000 |
| **22.000** | 45.237 | 15.494 | 16.637 | 12.065 | 1.3 | 1.3 | 29 200 | 33 500 | 8 500 | 11 000 |
| | 45.975 | 15.494 | 16.637 | 12.065 | 1.3 | 1.3 | 29 200 | 33 500 | 8 500 | 11 000 |
| **22.225** | 50.005 | 13.495 | 14.260 | 9.525 | 1.3 | 1.0 | 26 000 | 27 900 | 7 500 | 10 000 |
| | 50.005 | 17.526 | 18.288 | 13.970 | 1.3 | 1.3 | 38 500 | 40 000 | 8 000 | 11 000 |
| | 52.388 | 19.368 | 20.168 | 14.288 | 1.5 | 1.5 | 40 500 | 43 000 | 7 500 | 10 000 |
| | 53.975 | 19.368 | 20.168 | 14.288 | 1.5 | 1.5 | 40 500 | 43 000 | 7 500 | 10 000 |
| | 56.896 | 19.368 | 19.837 | 15.875 | 1.3 | 1.3 | 38 000 | 40 500 | 7 100 | 9 500 |
| | 57.150 | 22.225 | 22.225 | 17.462 | 0.8 | 1.5 | 48 000 | 50 000 | 7 100 | 9 500 |




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | 0 | 0.4 | $Y_1$ |

## Static Equivalent Load

$P_0=0.5F_r+Y_0F_a$

When $F_r>0.5F_r+Y_0F_a$, use $P_0=F_r$

The values of e, $Y_1$ and $Y_0$ are given in the table below.

| Bearing Numbers | | Abutment and Fillet Dimensions (mm) | | | | | | Eff. Load Centers (mm) | Constant | Axial Load Factors | | Mass (kg) approx. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Cone | Cup | | | | | | |
| CONE | CUP | $d_a$ | $d_b$ | $D_a$ | $D_b$ | $r_a$ max. | | a | e | $Y_1$ | $Y_0$ | CONE | CUP |
| *A 2047 | A 2126 | 16.5 | 15.5 | 26 | 29 | 0.8 | 1.3 | 6.8 | 0.41 | 1.5 | 0.81 | 0.023 | 0.017 |
| A 4050 | A 4138 | 18.5 | 17 | 29 | 32 | 1.3 | 1.3 | 8.2 | 0.45 | 1.3 | 0.73 | 0.033 | 0.022 |
| *A 4059 | A 4138 | 19.5 | 19 | 29 | 32 | 0.8 | 1.3 | 8.2 | 0.45 | 1.3 | 0.73 | 0.029 | 0.022 |
| L 21549 | L 21511 | 21.5 | 19.5 | 29 | 32.5 | 1.3 | 1.3 | 7.7 | 0.32 | 1.9 | 1.0 | 0.031 | 0.018 |
| A 6062 | A 6157 | 22 | 20.5 | 34 | 37 | 1.3 | 1.3 | 10.3 | 0.53 | 1.1 | 0.63 | 0.044 | 0.031 |
| 03062 | 03162 | 21.5 | 20 | 34 | 37.5 | 1.3 | 2 | 9.1 | 0.31 | 1.9 | 1.1 | 0.061 | 0.035 |
| 11590 | 11520 | 24.5 | 22.5 | 34.5 | 39.5 | 1.5 | 1.5 | 13.0 | 0.70 | 0.85 | 0.47 | 0.061 | 0.040 |
| 17580 | 17520 | 23 | 21 | 36.5 | 39 | 1.5 | 1.5 | 10.6 | 0.33 | 1.8 | 1.0 | 0.075 | 0.048 |
| 05062 | 05175 | 23.5 | 21 | 38 | 42 | 1.5 | 1.5 | 11.2 | 0.36 | 1.7 | 0.93 | 0.081 | 0.039 |
| 09062 | 09195 | 22 | 21.5 | 42 | 44.5 | 0.8 | 1.3 | 10.7 | 0.27 | 2.3 | 1.2 | 0.139 | 0.065 |
| *HM 81649 | **HM 81610 | 27.5 | 23 | 37.5 | 43 | 1 | 2 | 14.9 | 0.55 | 1.1 | 0.60 | 0.115 | 0.082 |
| A 6067 | A 6157 | 22 | 21 | 34 | 37 | 0.8 | 1.3 | 10.3 | 0.53 | 1.1 | 0.63 | 0.042 | 0.031 |
| A 5069 | A 5144 | 23.5 | 21.5 | 30 | 33.5 | 1.5 | 1.5 | 8.9 | 0.49 | 1.2 | 0.68 | 0.030 | 0.020 |
| † LM 11749 | † LM 11710 | 23 | 21.5 | 34 | 37 | 1.3 | 1.3 | 8.7 | 0.29 | 2.1 | 1.2 | 0.055 | 0.028 |
| 05068 | 05185 | 23 | 22.5 | 40.5 | 42.5 | 0.8 | 1.3 | 10.1 | 0.36 | 1.7 | 0.93 | 0.082 | 0.047 |
| A 6075 | A 6157 | 24 | 23 | 34 | 37 | 1 | 1.3 | 10.3 | 0.53 | 1.1 | 0.63 | 0.037 | 0.031 |
| † LM 11949 | † LM 11910 | 25 | 23.5 | 39.5 | 41.5 | 1.3 | 1.3 | 9.5 | 0.30 | 2.0 | 1.1 | 0.081 | 0.044 |
| 05075 | 05185 | 25 | 23.5 | 40.5 | 42.5 | 1.3 | 1.3 | 10.1 | 0.36 | 1.7 | 0.93 | 0.077 | 0.047 |
| 09067 | 09195 | 25.5 | 24 | 42 | 44.5 | 1.3 | 1.3 | 10.7 | 0.27 | 2.3 | 1.2 | 0.115 | 0.065 |
| 09078 | 09195 | 25.5 | 24 | 42 | 44.5 | 1.2 | 1.3 | 10.7 | 0.27 | 2.3 | 1.2 | 0.124 | 0.065 |
| 09067 | 09196 | 25.5 | 24 | 41.5 | 44.5 | 1.3 | 1.5 | 13.8 | 0.27 | 2.3 | 1.2 | 0.115 | 0.085 |
| 09074 | 09194 | 26 | 24 | 39 | 44.5 | 1.5 | 3.5 | 13.8 | 0.27 | 2.3 | 1.2 | 0.124 | 0.082 |
| 21075 | 21212 | 31.5 | 26 | 43 | 50 | 1.5 | 2.3 | 16.3 | 0.59 | 1.0 | 0.56 | 0.156 | 0.097 |
| 05079 | 05185 | 26.5 | 24 | 40.5 | 42.5 | 1.5 | 1.3 | 10.1 | 0.36 | 1.7 | 0.93 | 0.073 | 0.047 |
| 07079 | 07204 | 27.5 | 27 | 45 | 48 | 1.5 | 1.3 | 12.1 | 0.40 | 1.5 | 0.82 | 0.105 | 0.061 |
| 09081 | 09196 | 27.5 | 25.5 | 41.5 | 44.5 | 1.5 | 1.5 | 13.8 | 0.27 | 2.3 | 1.2 | 0.115 | 0.085 |
| 12580 | 12520 | 28.5 | 26 | 42.5 | 45.5 | 1.5 | 1.5 | 12.9 | 0.32 | 1.9 | 1.0 | 0.114 | 0.067 |
| † M 12649 | † M 12610 | 27.5 | 25.5 | 44 | 46 | 1.3 | 1.3 | 10.9 | 0.28 | 2.2 | 1.2 | 0.115 | 0.059 |
| *† LM 12749 | † LM 12710 | 27.5 | 26 | 39.5 | 42.5 | 1.3 | 1.3 | 10.0 | 0.31 | 2.0 | 1.1 | 0.078 | 0.038 |
| *† LM 12749 | † LM 12711 | 27.5 | 26 | 40 | 42.5 | 1.3 | 1.3 | 10.0 | 0.31 | 2.0 | 1.1 | 0.078 | 0.043 |
| 07087 | 07196 | 28.5 | 27 | 44.5 | 47 | 1.3 | 1 | 10.6 | 0.40 | 1.5 | 0.82 | 0.097 | 0.035 |
| † M 12648 | † M 12610 | 28.5 | 26.5 | 44 | 46 | 1.3 | 1.3 | 10.9 | 0.28 | 2.2 | 1.2 | 0.111 | 0.059 |
| 1380 | 1328 | 29.5 | 27 | 45 | 48.5 | 1.5 | 1.5 | 11.3 | 0.29 | 2.1 | 1.1 | 0.137 | 0.067 |
| 1380 | 1329 | 29.5 | 27 | 46 | 49 | 1.5 | 1.5 | 11.3 | 0.29 | 2.1 | 1.1 | 0.137 | 0.082 |
| 1755 | 1729 | 29 | 27.5 | 49 | 51 | 1.3 | 1.3 | 12.2 | 0.31 | 2.0 | 1.1 | 0.152 | 0.102 |
| 1280 | 1220 | 29.5 | 29 | 49 | 52 | 0.8 | 1.5 | 15.1 | 0.35 | 1.7 | 0.95 | 0.183 | 0.106 |

**Notes**

* The maximum bore diameter is listed and its tolerance is negative (See Table **7.4.1** on Page **A136**).

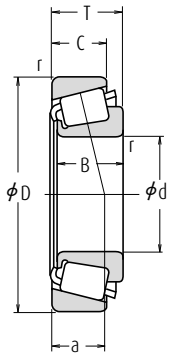
** The maximum outside diameter is listed and its tolerance is negative (See Table **7.4.2** on Pages **A136** and **A137**).

† The tolerances for the bore diameter and overall bearing width differ from the standard (See Table **5** on Page **B203**).

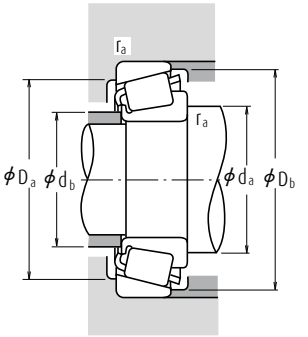
*† The tolerance for the bore diameter is 0 to −20 µm, and for overall bearing width is +356 to 0 µm.

# Single-Row Tapered Roller Bearings (Inch Design)

## Bore Diameter 22.606 – 28.575 mm




| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Limiting Speeds ($min^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cone | Cup | | | | |
| d | D | T | B | C | r min. | | $C_r$ | $C_{0r}$ | Grease | Oil |
| **22.606** | 47.000 | 15.500 | 15.500 | 12.000 | 1.5 | 1.0 | 26 300 | 30 000 | 8 000 | 11 000 |
| **23.812** | 50.292 | 14.224 | 14.732 | 10.668 | 1.5 | 1.3 | 27 600 | 32 000 | 7 100 | 10 000 |
| | 56.896 | 19.368 | 19.837 | 15.875 | 0.8 | 1.3 | 38 000 | 40 500 | 7 100 | 9 500 |
| **24.000** | 55.000 | 25.000 | 25.000 | 21.000 | 2.0 | 2.0 | 49 500 | 55 000 | 7 100 | 9 500 |
| **24.981** | 51.994 | 15.011 | 14.260 | 12.700 | 1.5 | 1.3 | 26 000 | 27 900 | 7 500 | 10 000 |
| | 52.001 | 15.011 | 14.260 | 12.700 | 1.5 | 2.0 | 26 000 | 27 900 | 7 500 | 10 000 |
| | 62.000 | 16.002 | 16.566 | 14.288 | 1.5 | 1.5 | 37 000 | 39 500 | 6 300 | 8 500 |
| **25.000** | 50.005 | 13.495 | 14.260 | 9.525 | 1.5 | 1.0 | 26 000 | 27 900 | 7 500 | 10 000 |
| | 51.994 | 15.011 | 14.260 | 12.700 | 1.5 | 1.3 | 26 000 | 27 900 | 7 500 | 10 000 |
| **25.400** | 50.005 | 13.495 | 14.260 | 9.525 | 3.3 | 1.0 | 26 000 | 27 900 | 7 500 | 10 000 |
| | 50.005 | 13.495 | 14.260 | 9.525 | 1.0 | 1.0 | 26 000 | 27 900 | 7 500 | 10 000 |
| | 50.292 | 14.224 | 14.732 | 10.668 | 1.3 | 1.3 | 27 600 | 32 000 | 7 100 | 10 000 |
| | 57.150 | 17.462 | 17.462 | 13.495 | 1.3 | 1.5 | 39 500 | 45 500 | 6 700 | 9 000 |
| | 57.150 | 19.431 | 19.431 | 14.732 | 1.5 | 1.5 | 42 500 | 49 000 | 6 700 | 9 000 |
| | 59.530 | 23.368 | 23.114 | 18.288 | 0.8 | 1.5 | 50 000 | 58 000 | 6 300 | 9 000 |
| | 62.000 | 19.050 | 20.638 | 14.288 | 0.8 | 1.3 | 46 000 | 53 000 | 6 000 | 8 000 |
| | 63.500 | 20.638 | 20.638 | 15.875 | 3.5 | 1.5 | 46 000 | 53 000 | 6 000 | 8 000 |
| | 64.292 | 21.433 | 21.433 | 16.670 | 1.5 | 1.5 | 51 000 | 64 500 | 5 600 | 8 000 |
| | 65.088 | 22.225 | 21.463 | 15.875 | 1.5 | 1.5 | 45 000 | 47 500 | 5 600 | 8 000 |
| | 68.262 | 22.225 | 22.225 | 17.462 | 0.8 | 1.5 | 55 000 | 64 000 | 5 600 | 7 500 |
| | 72.233 | 25.400 | 25.400 | 19.842 | 0.8 | 2.3 | 63 500 | 83 500 | 5 000 | 7 100 |
| | 72.626 | 24.608 | 24.257 | 17.462 | 2.3 | 1.5 | 60 000 | 58 000 | 5 600 | 7 500 |
| **26.988** | 50.292 | 14.224 | 14.732 | 10.668 | 3.5 | 1.3 | 27 600 | 32 000 | 7 100 | 10 000 |
| | 57.150 | 19.845 | 19.355 | 15.875 | 3.3 | 1.5 | 40 000 | 44 500 | 6 700 | 9 000 |
| | 60.325 | 19.842 | 17.462 | 15.875 | 3.5 | 1.5 | 39 500 | 45 500 | 6 700 | 9 000 |
| | 62.000 | 19.050 | 20.638 | 14.288 | 0.8 | 1.3 | 46 000 | 53 000 | 6 000 | 8 000 |
| **28.575** | 57.150 | 19.845 | 19.355 | 15.875 | 3.5 | 1.5 | 40 000 | 44 500 | 6 700 | 9 000 |
| | 59.131 | 15.875 | 16.764 | 11.811 | spec. | 1.3 | 34 500 | 41 500 | 6 300 | 8 500 |
| | 62.000 | 19.050 | 20.638 | 14.288 | 3.5 | 1.3 | 46 000 | 53 000 | 6 000 | 8 000 |
| | 62.000 | 19.050 | 20.638 | 14.288 | 0.8 | 1.3 | 46 000 | 53 000 | 6 000 | 8 000 |
| | 64.292 | 21.433 | 21.433 | 16.670 | 1.5 | 1.5 | 51 000 | 64 500 | 5 600 | 8 000 |
| | 68.262 | 22.225 | 22.225 | 17.462 | 0.8 | 1.5 | 55 000 | 64 000 | 5 600 | 7 500 |
| | 72.626 | 24.608 | 24.257 | 17.462 | 4.8 | 1.5 | 60 000 | 58 000 | 5 600 | 7 500 |
| | 72.626 | 24.608 | 24.257 | 17.462 | 1.5 | 1.5 | 60 000 | 58 000 | 5 600 | 7 500 |
| | 73.025 | 22.225 | 22.225 | 17.462 | 0.8 | 3.3 | 54 500 | 64 500 | 5 300 | 7 100 |




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | 0 | 0.4 | $Y_1$ |

## Static Equivalent Load

$P_0=0.5F_r+Y_0F_a$

When $F_r>0.5F_r+Y_0F_a$, use $P_0=F_r$

The values of e, $Y_1$ and $Y_0$ are given in the table below.

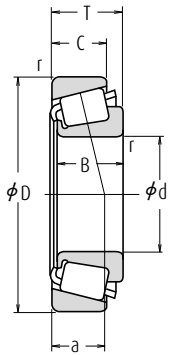
| Bearing Numbers | | Abutment and Fillet Dimensions (mm) | | | | | | Eff. Load Centers (mm) | Constant | Axial Load Factors | | Mass (kg) approx. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Cone | Cup | | | | | | |
| CONE | CUP | $d_a$ | $d_b$ | $D_a$ | $D_b$ | $r_a$ max. | | a | e | $Y_1$ | $Y_0$ | CONE | CUP |
| LM 72849 | LM 72810 | 29 | 27 | 40.5 | 44.5 | 1.5 | 1 | 12.2 | 0.47 | 1.3 | 0.70 | 0.086 | 0.046 |
| † L 44640 | † L 44610 | 30.5 | 28.5 | 44.5 | 47 | 1.5 | 1.3 | 10.9 | 0.37 | 1.6 | 0.88 | 0.097 | 0.039 |
| 1779 | 1729 | 29.5 | 28.5 | 49 | 51 | 0.8 | 1.3 | 12.2 | 0.31 | 2.0 | 1.1 | 0.143 | 0.102 |
| ▲ JHM 33449 | ▲ JHM 33410 | 35 | 30 | 47 | 52 | 2 | 2 | 15.8 | 0.35 | 1.7 | 0.93 | 0.181 | 0.107 |
| 07098 | 07204 | 31 | 29 | 45 | 48 | 1.5 | 1.3 | 12.1 | 0.40 | 1.5 | 0.82 | 0.085 | 0.061 |
| 07098 | 07205 | 31 | 29 | 44.5 | 48 | 1.5 | 2 | 12.1 | 0.40 | 1.5 | 0.82 | 0.085 | 0.061 |
| 17098 | 17244 | 33 | 30.5 | 54 | 57 | 1.5 | 1.5 | 12.8 | 0.38 | 1.6 | 0.86 | 0.165 | 0.091 |
| 07097 | 07196 | 31 | 29 | 44.5 | 47 | 1.5 | 1 | 10.6 | 0.40 | 1.5 | 0.82 | 0.085 | 0.035 |
| 07097 | 07204 | 31 | 29 | 45 | 48 | 1.5 | 1.3 | 12.1 | 0.40 | 1.5 | 0.82 | 0.085 | 0.061 |
| 07100 SA | 07196 | 35 | 29.5 | 44.5 | 47 | 3.3 | 1 | 10.6 | 0.40 | 1.5 | 0.82 | 0.082 | 0.035 |
| 07100 | 07196 | 30.5 | 29.5 | 44.5 | 47 | 1 | 1 | 10.6 | 0.40 | 1.5 | 0.82 | 0.084 | 0.035 |
| † L 44643 | † L 44610 | 31.5 | 29.5 | 44.5 | 47 | 1.3 | 1.3 | 10.9 | 0.37 | 1.6 | 0.88 | 0.090 | 0.039 |
| 15578 | 15520 | 32.5 | 30.5 | 51 | 53 | 1.3 | 1.5 | 12.4 | 0.35 | 1.7 | 0.95 | 0.151 | 0.070 |
| M 84548 | M 84510 | 36 | 33 | 48.5 | 54 | 1.5 | 1.5 | 16.1 | 0.55 | 1.1 | 0.60 | 0.156 | 0.089 |
| M 84249 | M 84210 | 36 | 32.5 | 49.5 | 56 | 0.8 | 1.5 | 18.3 | 0.55 | 1.1 | 0.60 | 0.194 | 0.13 |
| 15101 | 15245 | 32.5 | 31.5 | 55 | 58 | 0.8 | 1.3 | 13.3 | 0.35 | 1.7 | 0.94 | 0.222 | 0.081 |
| 15100 | 15250 X | 38 | 31.5 | 55 | 59 | 3.5 | 1.5 | 14.9 | 0.35 | 1.7 | 0.94 | 0.22 | 0.113 |
| M 86643 | M 86610 | 38 | 36.5 | 54 | 61 | 1.5 | 1.5 | 17.7 | 0.55 | 1.1 | 0.60 | 0.246 | 0.128 |
| 23100 | 23256 | 39 | 34.5 | 53 | 61 | 1.5 | 1.5 | 20.0 | 0.73 | 0.82 | 0.45 | 0.214 | 0.142 |
| 02473 | 02420 | 34.5 | 33.5 | 59 | 63 | 0.8 | 1.5 | 16.9 | 0.42 | 1.4 | 0.79 | 0.28 | 0.152 |
| HM 88630 | HM 88610 | 39.5 | 39.5 | 60 | 69 | 0.8 | 2.3 | 20.7 | 0.55 | 1.1 | 0.60 | 0.398 | 0.188 |
| 41100 | 41286 | 41 | 36.5 | 61 | 68 | 2.3 | 1.5 | 20.7 | 0.60 | 1.0 | 0.55 | 0.32 | 0.177 |
| † L 44649 | † L 44610 | 37.5 | 31 | 44.5 | 47 | 3.5 | 1.3 | 10.9 | 0.37 | 1.6 | 0.88 | 0.081 | 0.039 |
| 1997 X | 1922 | 37.5 | 31.5 | 51 | 53.5 | 3.3 | 1.5 | 13.9 | 0.33 | 1.8 | 1.0 | 0.152 | 0.077 |
| 15580 | 15523 | 38.5 | 32 | 51 | 54 | 3.5 | 1.5 | 14.7 | 0.35 | 1.7 | 0.95 | 0.141 | 0.123 |
| 15106 | 15245 | 33.5 | 33 | 55 | 58 | 0.8 | 1.3 | 13.3 | 0.35 | 1.7 | 0.94 | 0.211 | 0.081 |
| 1988 | 1922 | 39.5 | 33.5 | 51 | 53.5 | 3.5 | 1.5 | 13.9 | 0.33 | 1.8 | 1.0 | 0.141 | 0.077 |
| † LM 67043 | † LM 67010 | 40 | 33.5 | 52 | 56 | 3.5 | 1.3 | 12.6 | 0.41 | 1.5 | 0.80 | 0.147 | 0.062 |
| 15112 | 15245 | 40 | 34 | 55 | 58 | 3.5 | 1.3 | 13.3 | 0.35 | 1.7 | 0.94 | 0.199 | 0.081 |
| 15113 | 15245 | 34.5 | 34 | 55 | 58 | 0.8 | 1.3 | 13.3 | 0.35 | 1.7 | 0.94 | 0.20 | 0.081 |
| M 86647 | M 86610 | 40 | 38 | 54 | 61 | 1.5 | 1.5 | 17.7 | 0.55 | 1.1 | 0.60 | 0.223 | 0.128 |
| 02474 | 02420 | 36.5 | 36 | 59 | 63 | 0.8 | 1.5 | 16.9 | 0.42 | 1.4 | 0.79 | 0.257 | 0.152 |
| 41125 | 41286 | 48 | 36.5 | 61 | 68 | 4.8 | 1.5 | 20.7 | 0.60 | 1.0 | 0.55 | 0.292 | 0.177 |
| 41126 | 41286 | 41.5 | 36.5 | 61 | 68 | 1.5 | 1.5 | 20.7 | 0.60 | 1.0 | 0.55 | 0.295 | 0.177 |
| 02872 | 02820 | 37.5 | 37 | 62 | 68 | 0.8 | 3.3 | 18.3 | 0.45 | 1.3 | 0.73 | 0.321 | 0.16 |

**Notes** † The tolerances for the bore diameter and overall bearing width differ from the standard (See Table **5** on Page **B203**).

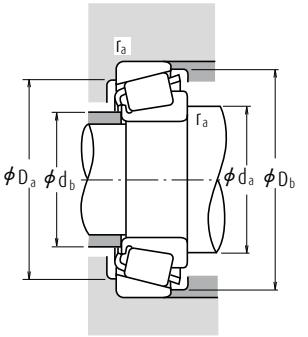
▲ The tolerances are listed in Tables **2, 3** and **4** on Pages **B202** and **B203**.

# Single-Row Tapered Roller Bearings (Inch Design)

## Bore Diameter 29.000 – 32.000 mm




| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Limiting Speeds ($min^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cone | Cup | | | | |
| d | D | T | B | C | r min. | | $C_r$ | $C_{0r}$ | Grease | Oil |
| **29.000** | 50.292 | 14.224 | 14.732 | 10.668 | 3.5 | 1.3 | 26 800 | 34 000 | 7 100 | 9 500 |
| **29.367** | 66.421 | 23.812 | 25.433 | 19.050 | 3.5 | 1.3 | 65 000 | 73 000 | 6 000 | 8 000 |
| **30.000** | 62.000 | 16.002 | 16.566 | 14.288 | 1.5 | 1.5 | 37 000 | 39 500 | 6 300 | 8 500 |
| | 62.000 | 19.050 | 20.638 | 14.288 | 1.3 | 1.3 | 46 000 | 53 000 | 6 000 | 8 000 |
| | 63.500 | 20.638 | 20.638 | 15.875 | 1.3 | 1.3 | 46 000 | 53 000 | 6 000 | 8 000 |
| | 72.000 | 19.000 | 18.923 | 15.875 | 1.5 | 1.5 | 52 000 | 56 000 | 5 600 | 7 500 |
| **30.112** | 62.000 | 19.050 | 20.638 | 14.288 | 0.8 | 1.3 | 46 000 | 53 000 | 6 000 | 8 000 |
| **30.162** | 58.738 | 14.684 | 15.080 | 10.716 | 3.5 | 1.0 | 28 800 | 33 500 | 6 000 | 8 000 |
| | 64.292 | 21.433 | 21.433 | 16.670 | 1.5 | 1.5 | 51 000 | 64 500 | 5 600 | 8 000 |
| | 68.262 | 22.225 | 22.225 | 17.462 | 2.3 | 1.5 | 55 500 | 70 500 | 5 300 | 7 500 |
| | 69.850 | 23.812 | 25.357 | 19.050 | 2.3 | 1.3 | 71 000 | 84 000 | 5 600 | 7 500 |
| | 69.850 | 23.812 | 25.357 | 19.050 | 0.8 | 1.3 | 71 000 | 84 000 | 5 600 | 7 500 |
| | 76.200 | 24.608 | 24.074 | 16.670 | 1.5 | C3.3 | 67 500 | 69 500 | 5 000 | 6 700 |
| **30.213** | 62.000 | 19.050 | 20.638 | 14.288 | 3.5 | 1.3 | 46 000 | 53 000 | 6 000 | 8 000 |
| | 62.000 | 19.050 | 20.638 | 14.288 | 0.8 | 1.3 | 46 000 | 53 000 | 6 000 | 8 000 |
| | 62.000 | 19.050 | 20.638 | 14.288 | 1.5 | 1.3 | 46 000 | 53 000 | 6 000 | 8 000 |
| **30.955** | 64.292 | 21.433 | 21.433 | 16.670 | 1.5 | 1.5 | 51 000 | 64 500 | 5 600 | 8 000 |
| **31.750** | 58.738 | 14.684 | 15.080 | 10.716 | 1.0 | 1.0 | 28 800 | 33 500 | 6 000 | 8 000 |
| | 59.131 | 15.875 | 16.764 | 11.811 | spec. | 1.3 | 34 500 | 41 500 | 6 300 | 8 500 |
| | 62.000 | 18.161 | 19.050 | 14.288 | spec. | 1.3 | 46 000 | 53 000 | 6 000 | 8 000 |
| | 62.000 | 19.050 | 20.638 | 14.288 | 0.8 | 1.3 | 46 000 | 53 000 | 6 000 | 8 000 |
| | 62.000 | 19.050 | 20.638 | 14.288 | 3.5 | 1.3 | 46 000 | 53 000 | 6 000 | 8 000 |
| | 63.500 | 20.638 | 20.638 | 15.875 | 0.8 | 1.3 | 46 000 | 53 000 | 6 000 | 8 000 |
| | 68.262 | 22.225 | 22.225 | 17.462 | 3.5 | 1.5 | 55 000 | 64 000 | 5 600 | 7 500 |
| | 68.262 | 22.225 | 22.225 | 17.462 | 1.5 | 1.5 | 55 500 | 70 500 | 5 300 | 7 500 |
| | 69.012 | 19.845 | 19.583 | 15.875 | 3.5 | 1.3 | 47 000 | 56 000 | 5 600 | 7 500 |
| | 69.012 | 26.982 | 26.721 | 15.875 | 4.3 | 3.3 | 47 000 | 56 000 | 5 600 | 7 500 |
| | 69.850 | 23.812 | 25.357 | 19.050 | 0.8 | 1.3 | 71 000 | 84 000 | 5 600 | 7 500 |
| | 69.850 | 23.812 | 25.357 | 19.050 | 3.5 | 1.3 | 71 000 | 84 000 | 5 600 | 7 500 |
| | 72.626 | 30.162 | 29.997 | 23.812 | 0.8 | 3.3 | 79 500 | 90 000 | 5 300 | 7 500 |
| | 73.025 | 29.370 | 27.783 | 23.020 | 1.3 | 3.3 | 74 000 | 100 000 | 5 000 | 7 100 |
| | 80.000 | 21.000 | 22.403 | 17.826 | 0.8 | 1.3 | 68 500 | 75 500 | 4 500 | 6 300 |
| **32.000** | 72.233 | 25.400 | 25.400 | 19.842 | 3.3 | 2.3 | 63 500 | 83 500 | 5 000 | 7 100 |




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | 0 | 0.4 | $Y_1$ |

## Static Equivalent Load

$P_0=0.5F_r+Y_0F_a$

When $F_r>0.5F_r+Y_0F_a$, use $P_0=F_r$

The values of e, $Y_1$ and $Y_0$ are given in the table below.

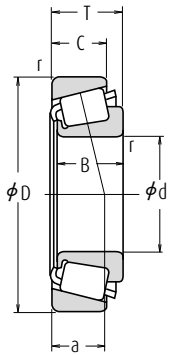
| Bearing Numbers | | Abutment and Fillet Dimensions (mm) | | | | | | Eff. Load Centers (mm) | Constant | Axial Load Factors | | Mass (kg) approx. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Cone | Cup | | | | | | |
| CONE | CUP | $d_a$ | $d_b$ | $D_a$ | $D_b$ | $r_a$ max. | | a | e | $Y_1$ | $Y_0$ | CONE | CUP |
| † L 45449 | † L 45410 | 39.5 | 33 | 44.5 | 48 | 3.5 | 1.3 | 10.8 | 0.37 | 1.6 | 0.89 | 0.079 | 0.036 |
| 2690 | 2631 | 41 | 35 | 58 | 60 | 3.5 | 1.3 | 14.3 | 0.25 | 2.4 | 1.3 | 0.242 | 0.165 |
| * 17118 | 17244 | 37 | 34.5 | 54 | 57 | 1.5 | 1.5 | 12.8 | 0.38 | 1.6 | 0.86 | 0.136 | 0.091 |
| * 15117 | 15245 | 36.5 | 35 | 55 | 58 | 1.3 | 1.3 | 13.3 | 0.35 | 1.7 | 0.94 | 0.189 | 0.081 |
| * 15117 | 15250 | 36.5 | 35 | 56 | 59 | 1.3 | 1.3 | 14.9 | 0.35 | 1.7 | 0.94 | 0.189 | 0.113 |
| * 26118 | 26283 | 38 | 36 | 62 | 65 | 1.5 | 1.5 | 14.8 | 0.36 | 1.7 | 0.92 | 0.225 | 0.163 |
| 15116 | 15245 | 36 | 35.5 | 55 | 58 | 0.8 | 1.3 | 13.3 | 0.35 | 1.7 | 0.94 | 0.189 | 0.081 |
| 08118 | 08231 | 41.5 | 35 | 52 | 55 | 3.5 | 1 | 13.3 | 0.47 | 1.3 | 0.70 | 0.12 | 0.057 |
| M 86649 | M 86610 | 41 | 38 | 54 | 61 | 1.5 | 1.5 | 17.7 | 0.55 | 1.1 | 0.60 | 0.211 | 0.128 |
| M 88043 | M 88010 | 43.5 | 39.5 | 58 | 65 | 2.3 | 1.5 | 19.1 | 0.55 | 1.1 | 0.60 | 0.263 | 0.146 |
| 2558 | 2523 | 40 | 36.5 | 61 | 64 | 2.3 | 1.3 | 14.5 | 0.27 | 2.2 | 1.2 | 0.297 | 0.169 |
| 2559 | 2523 | 37 | 36.5 | 61 | 64 | 0.8 | 1.3 | 14.5 | 0.27 | 2.2 | 1.2 | 0.298 | 0.169 |
| 43118 | 43300 | 45 | 42 | 64 | 73 | 1.5 | 3.3 | 22.9 | 0.67 | 0.90 | 0.49 | 0.383 | 0.146 |
| 15118 | 15245 | 41.5 | 35.5 | 55 | 58 | 3.5 | 1.3 | 13.3 | 0.35 | 1.7 | 0.94 | 0.186 | 0.081 |
| 15120 | 15245 | 36 | 35.5 | 55 | 58 | 0.8 | 1.3 | 13.3 | 0.35 | 1.7 | 0.94 | 0.188 | 0.081 |
| 15119 | 15245 | 37.5 | 35.5 | 55 | 58 | 1.5 | 1.3 | 13.3 | 0.35 | 1.7 | 0.94 | 0.188 | 0.081 |
| M 86648 A | M 86610 | 42 | 38 | 54 | 61 | 1.5 | 1.5 | 17.7 | 0.55 | 1.1 | 0.60 | 0.205 | 0.128 |
| 08125 | 08231 | 37.5 | 36 | 52 | 55 | 1 | 1 | 13.3 | 0.47 | 1.3 | 0.70 | 0.113 | 0.057 |
| † LM 67048 | † LM 67010 | 42.5 | 36 | 52 | 56 | 3.5 | 1.3 | 12.6 | 0.41 | 1.5 | 0.80 | 0.127 | 0.062 |
| 15123 | 15245 | 42.5 | 36.5 | 55 | 58 | 3.5 | 1.3 | 13.3 | 0.35 | 1.7 | 0.94 | 0.165 | 0.081 |
| 15126 | 15245 | 37 | 36.5 | 55 | 58 | 0.8 | 1.3 | 13.3 | 0.35 | 1.7 | 0.94 | 0.176 | 0.081 |
| 15125 | 15245 | 42.5 | 36.5 | 55 | 58 | 3.5 | 1.3 | 13.3 | 0.35 | 1.7 | 0.94 | 0.174 | 0.081 |
| 15126 | 15250 | 37 | 36.5 | 56 | 59 | 0.8 | 1.3 | 14.9 | 0.35 | 1.7 | 0.94 | 0.176 | 0.113 |
| 02475 | 02420 | 44.5 | 38.5 | 59 | 63 | 3.5 | 1.5 | 16.9 | 0.42 | 1.4 | 0.79 | 0.229 | 0.152 |
| M 88046 | M 88010 | 43 | 40.5 | 58 | 65 | 1.5 | 1.5 | 19.1 | 0.55 | 1.1 | 0.60 | 0.25 | 0.146 |
| 14125 A | 14276 | 44 | 37.5 | 60 | 63 | 3.5 | 1.3 | 15.3 | 0.38 | 1.6 | 0.86 | 0.219 | 0.135 |
| 14123 A | 14274 | 41.5 | 37.5 | 59 | 63 | 4.3 | 3.3 | 15.1 | 0.38 | 1.6 | 0.87 | 0.289 | 0.132 |
| 2580 | 2523 | 38.5 | 37.5 | 61 | 64 | 0.8 | 1.3 | 14.5 | 0.27 | 2.2 | 1.2 | 0.282 | 0.169 |
| 2582 | 2523 | 44 | 37.5 | 61 | 64 | 3.5 | 1.3 | 14.5 | 0.27 | 2.2 | 1.2 | 0.28 | 0.169 |
| 3188 | 3120 | 39.5 | 39.5 | 61 | 67 | 0.8 | 3.3 | 19.6 | 0.33 | 1.8 | 0.99 | 0.368 | 0.225 |
| HM 88542 | HM 88510 | 45.5 | 42.5 | 59 | 70 | 1.3 | 3.3 | 23.5 | 0.55 | 1.1 | 0.60 | 0.379 | 0.242 |
| 346 | 332 | 40 | 39.5 | 73 | 75 | 0.8 | 1.3 | 14.6 | 0.27 | 2.2 | 1.2 | 0.419 | 0.146 |
| *HM 88638 | HM 88610 | 48.5 | 42.5 | 60 | 69 | 3.3 | 2.3 | 20.7 | 0.55 | 1.1 | 0.60 | 0.337 | 0.188 |

**Notes** * The maximum bore diameter is listed and its tolerance is negative (See Table **7.4.1** on Page **A136**).

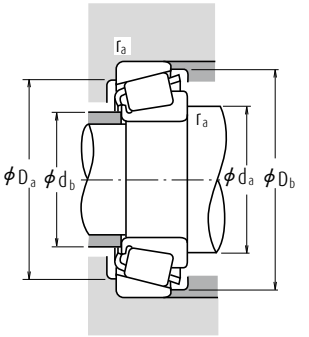
† The tolerances for the bore diameter and overall bearing width differ from the standard (See Table **5** on Page **B203**).

# Single-Row Tapered Roller Bearings (Inch Design)

## Bore Diameter 33.338 – 35.000 mm




| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Limiting Speeds ($min^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cone | Cup | | | | |
| d | D | T | B | C | r min. | | $C_r$ | $C_{0r}$ | Grease | Oil |
| **33.338** | 66.675 | 20.638 | 20.638 | 15.875 | 3.5 | 1.5 | 46 000 | 53 500 | 5 600 | 7 500 |
| | 68.262 | 22.225 | 22.225 | 17.462 | 0.8 | 1.5 | 55 500 | 70 500 | 5 300 | 7 500 |
| | 69.012 | 19.845 | 19.583 | 15.875 | 3.5 | 3.3 | 47 000 | 56 000 | 5 600 | 7 500 |
| | 69.012 | 19.845 | 19.583 | 15.875 | 0.8 | 1.3 | 47 000 | 56 000 | 5 600 | 7 500 |
| | 69.850 | 23.812 | 25.357 | 19.050 | 3.5 | 1.3 | 71 000 | 84 000 | 5 600 | 7 500 |
| | 72.000 | 19.000 | 18.923 | 15.875 | 3.5 | 1.5 | 52 000 | 56 000 | 5 600 | 7 500 |
| | 72.626 | 30.162 | 29.997 | 23.812 | 0.8 | 3.3 | 79 500 | 90 000 | 5 300 | 7 500 |
| | 73.025 | 29.370 | 27.783 | 23.020 | 0.8 | 3.3 | 74 000 | 100 000 | 5 000 | 7 100 |
| | 76.200 | 29.370 | 28.575 | 23.020 | 3.8 | 0.8 | 78 500 | 106 000 | 4 800 | 6 700 |
| | 76.200 | 29.370 | 28.575 | 23.020 | 0.8 | 3.3 | 78 500 | 106 000 | 4 800 | 6 700 |
| | 79.375 | 25.400 | 24.074 | 17.462 | 3.5 | 1.5 | 67 500 | 69 500 | 5 000 | 6 700 |
| **34.925** | 65.088 | 18.034 | 18.288 | 13.970 | spec. | 1.3 | 47 500 | 57 500 | 5 600 | 7 500 |
| | 65.088 | 20.320 | 18.288 | 16.256 | spec. | 1.3 | 47 500 | 57 500 | 5 600 | 7 500 |
| | 66.675 | 20.638 | 20.638 | 16.670 | 3.5 | 2.3 | 53 000 | 62 500 | 5 600 | 7 500 |
| | 69.012 | 19.845 | 19.583 | 15.875 | 3.5 | 1.3 | 47 000 | 56 000 | 5 600 | 7 500 |
| | 69.012 | 19.845 | 19.583 | 15.875 | 1.5 | 1.3 | 47 000 | 56 000 | 5 600 | 7 500 |
| | 72.233 | 25.400 | 25.400 | 19.842 | 2.3 | 2.3 | 63 500 | 83 500 | 5 000 | 7 100 |
| | 73.025 | 22.225 | 22.225 | 17.462 | 0.8 | 3.3 | 54 500 | 64 500 | 5 300 | 7 100 |
| | 73.025 | 22.225 | 23.812 | 17.462 | 3.5 | 3.3 | 63 500 | 77 000 | 5 300 | 7 100 |
| | 73.025 | 23.812 | 24.608 | 19.050 | 1.5 | 0.8 | 71 000 | 86 000 | 5 300 | 7 100 |
| | 73.025 | 23.812 | 24.608 | 19.050 | 3.5 | 2.3 | 71 000 | 86 000 | 5 300 | 7 100 |
| | 76.200 | 29.370 | 28.575 | 23.020 | 0.8 | 0.8 | 78 500 | 106 000 | 4 800 | 6 700 |
| | 76.200 | 29.370 | 28.575 | 23.020 | 3.5 | 0.8 | 78 500 | 106 000 | 4 800 | 6 700 |
| | 76.200 | 29.370 | 28.575 | 23.020 | 3.5 | 3.3 | 78 500 | 106 000 | 4 800 | 6 700 |
| | 76.200 | 29.370 | 28.575 | 23.812 | 1.5 | 3.3 | 80 500 | 96 500 | 5 000 | 6 700 |
| | 79.375 | 29.370 | 29.771 | 23.812 | 3.5 | 3.3 | 88 000 | 106 000 | 4 800 | 6 700 |
| **34.976** | 68.262 | 15.875 | 16.520 | 11.908 | 1.5 | 1.5 | 45 000 | 53 500 | 5 300 | 7 100 |
| | 72.085 | 22.385 | 19.583 | 18.415 | 1.3 | 2.3 | 47 000 | 56 000 | 5 600 | 7 500 |
| | 80.000 | 21.006 | 20.940 | 15.875 | 1.5 | 1.5 | 56 500 | 64 500 | 5 000 | 6 700 |
| **35.000** | 59.131 | 15.875 | 16.764 | 11.938 | spec. | 1.3 | 35 000 | 47 000 | 6 000 | 8 000 |
| | 59.975 | 15.875 | 16.764 | 11.938 | spec. | 1.3 | 35 000 | 47 000 | 6 000 | 8 000 |
| | 62.000 | 16.700 | 17.000 | 13.600 | spec. | 1.0 | 38 000 | 50 000 | 5 600 | 8 000 |
| | 62.000 | 16.700 | 17.000 | 13.600 | spec. | 1.5 | 38 000 | 50 000 | 5 600 | 8 000 |
| | 65.987 | 20.638 | 20.638 | 16.670 | 3.5 | 2.3 | 53 000 | 62 500 | 5 600 | 7 500 |
| | 73.025 | 26.988 | 26.975 | 22.225 | 3.5 | 0.8 | 75 500 | 88 500 | 5 300 | 7 500 |




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | 0 | 0.4 | $Y_1$ |

## Static Equivalent Load

$P_0=0.5F_r+Y_0F_a$

When $F_r>0.5F_r+Y_0F_a$, use $P_0=F_r$

The values of e, $Y_1$ and $Y_0$ are given in the table below.

| Bearing Numbers | | Abutment and Fillet Dimensions (mm) | | | | | | Eff. Load Centers (mm) | Constant | Axial Load Factors | | Mass (kg) approx. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Cone | Cup | | | | | | |
| CONE | CUP | $d_a$ | $d_b$ | $D_a$ | $D_b$ | $r_a$ max. | | a | e | $Y_1$ | $Y_0$ | CONE | CUP |
| 1680 | 1620 | 44.5 | 38.5 | 58 | 61 | 3.5 | 1.5 | 15.2 | 0.37 | 1.6 | 0.89 | 0.196 | 0.121 |
| M 88048 | M 88010 | 42.5 | 41 | 58 | 65 | 0.8 | 1.5 | 19.0 | 0.55 | 1.1 | 0.60 | 0.236 | 0.146 |
| 14130 | 14274 | 45 | 38.5 | 59 | 63 | 3.5 | 3.3 | 15.3 | 0.38 | 1.6 | 0.86 | 0.207 | 0.132 |
| 14131 | 14276 | 39.5 | 38.5 | 60 | 63 | 0.8 | 1.3 | 15.3 | 0.38 | 1.6 | 0.86 | 0.209 | 0.135 |
| 2585 | 2523 | 45 | 39 | 61 | 64 | 3.5 | 1.3 | 14.5 | 0.27 | 2.2 | 1.2 | 0.263 | 0.169 |
| 26131 | 26283 | 44.5 | 38.5 | 62 | 65 | 3.5 | 1.5 | 14.7 | 0.36 | 1.7 | 0.92 | 0.20 | 0.163 |
| 3197 | 3120 | 41.5 | 40.5 | 61 | 67 | 0.8 | 3.3 | 19.6 | 0.33 | 1.8 | 0.99 | 0.348 | 0.225 |
| HM 88547 | HM 88510 | 45.5 | 42.5 | 59 | 70 | 0.8 | 3.3 | 23.5 | 0.55 | 1.1 | 0.60 | 0.362 | 0.242 |
| HM 89444 | HM 89411 | 53 | 44.5 | 65 | 73 | 3.8 | 0.8 | 23.6 | 0.55 | 1.1 | 0.60 | 0.419 | 0.261 |
| HM 89443 | HM 89410 | 46.5 | 44.5 | 62 | 73 | 0.8 | 3.3 | 23.6 | 0.55 | 1.1 | 0.60 | 0.421 | 0.257 |
| 43131 | 43312 | 51 | 42 | 67 | 74 | 3.5 | 1.5 | 23.7 | 0.67 | 0.90 | 0.49 | 0.348 | 0.22 |
| † LM 48548 | † LM 48510 | 46 | 40 | 58 | 61 | 3.5 | 1.3 | 14.1 | 0.38 | 1.6 | 0.88 | 0.172 | 0.087 |
| † LM 48548 | † LM 48511 | 46 | 40 | 58 | 61 | 3.5 | 1.3 | 16.4 | 0.38 | 1.6 | 0.88 | 0.172 | 0.108 |
| M 38549 | M 38510 | 46.5 | 40 | 58 | 62 | 3.5 | 2.3 | 15.2 | 0.35 | 1.7 | 0.94 | 0.194 | 0.112 |
| 14138 A | 14276 | 46 | 40 | 60 | 63 | 3.5 | 1.3 | 15.3 | 0.38 | 1.6 | 0.86 | 0.194 | 0.135 |
| 14137 A | 14276 | 42 | 40 | 60 | 63 | 1.5 | 1.3 | 15.1 | 0.38 | 1.6 | 0.86 | 0.196 | 0.135 |
| HM 88649 | HM 88610 | 48.5 | 42.5 | 60 | 69 | 2.3 | 2.3 | 20.7 | 0.55 | 1.1 | 0.60 | 0.307 | 0.188 |
| 02878 | 02820 | 42.5 | 42 | 62 | 68 | 0.8 | 3.3 | 18.3 | 0.45 | 1.3 | 0.73 | 0.266 | 0.16 |
| 2877 | 2820 | 47 | 41.5 | 63 | 68 | 3.5 | 3.3 | 16.1 | 0.37 | 1.6 | 0.90 | 0.291 | 0.15 |
| 25877 | 25821 | 43 | 40.5 | 65 | 68 | 1.5 | 0.8 | 15.7 | 0.29 | 2.1 | 1.1 | 0.306 | 0.167 |
| 25878 | 25820 | 47 | 40.5 | 64 | 68 | 3.5 | 2.3 | 15.7 | 0.29 | 2.1 | 1.1 | 0.304 | 0.165 |
| HM 89446 A | HM 89411 | 47.5 | 44.5 | 65 | 73 | 0.8 | 0.8 | 23.6 | 0.55 | 1.1 | 0.60 | 0.403 | 0.261 |
| HM 89446 | HM 89411 | 53 | 44.5 | 65 | 73 | 3.5 | 0.8 | 23.6 | 0.55 | 1.1 | 0.60 | 0.40 | 0.261 |
| HM 89446 | HM 89410 | 53 | 44.5 | 62 | 73 | 3.5 | 3.3 | 23.6 | 0.55 | 1.1 | 0.60 | 0.40 | 0.257 |
| 31594 | 31520 | 46 | 43.5 | 64 | 72 | 1.5 | 3.3 | 21.6 | 0.40 | 1.5 | 0.82 | 0.404 | 0.235 |
| 3478 | 3420 | 50 | 43.5 | 67 | 74 | 3.5 | 3.3 | 20.0 | 0.37 | 1.6 | 0.90 | 0.448 | 0.259 |
| 19138 | 19268 | 42.5 | 40.5 | 61 | 65 | 1.5 | 1.5 | 14.5 | 0.44 | 1.4 | 0.74 | 0.196 | 0.073 |
| 14139 | 14283 | 41.5 | 40 | 60 | 65 | 1.3 | 2.3 | 17.7 | 0.38 | 1.6 | 0.87 | 0.198 | 0.21 |
| 28138 | 28315 | 43.5 | 41 | 69 | 73 | 1.5 | 1.5 | 16.0 | 0.40 | 1.5 | 0.82 | 0.308 | 0.199 |
| *† L 68149 | † L 68110 | 45.5 | 39 | 52 | 56 | 3.5 | 1.3 | 13.2 | 0.42 | 1.4 | 0.79 | 0.117 | 0.056 |
| *† L 68149 | † L 68111 | 45.5 | 39 | 53 | 56 | 3.5 | 1.3 | 13.2 | 0.42 | 1.4 | 0.79 | 0.117 | 0.064 |
| * LM 78349 | ** LM 78310 | 46 | 40 | 55 | 59 | 3.5 | 1 | 14.4 | 0.44 | 1.4 | 0.74 | 0.137 | 0.074 |
| * LM 78349 | ** LM 78310 A | 46 | 40 | 54 | 59 | 3.5 | 1.5 | 14.4 | 0.44 | 1.4 | 0.74 | 0.138 | 0.073 |
| M 38547 | M 38511 | 46 | 39.5 | 59 | 61 | 3.5 | 2.3 | 15.2 | 0.35 | 1.7 | 0.94 | 0.193 | 0.103 |
| 23691 | 23621 | 49 | 42 | 63 | 68 | 3.5 | 0.8 | 18.1 | 0.37 | 1.6 | 0.89 | 0.309 | 0.212 |

**Notes**

* The maximum bore diameter is listed and its tolerance is negative (See Table **7.4.1** on Page **A136**).

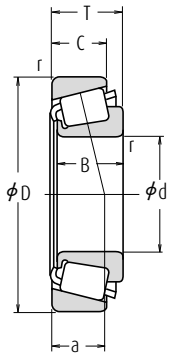
** The maximum outside diameter is listed and its tolerance is negative (See Table **7.4.2** on Pages **A136** and **A137**).

† The tolerances for the bore diameter and overall bearing width differ from the standard (See Table **5** on Page **B203**).

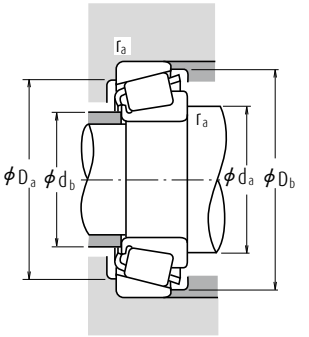
*† The tolerance for the bore diameter is 0 to −20 µm, and for overall bearing width is +356 to 0 µm.

# Single-Row Tapered Roller Bearings (Inch Design)

## Bore Diameter 35.717 – 41.275 mm




| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Limiting Speeds ($min^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cone | Cup | | | | |
| d | D | T | B | C | r min. | | $C_r$ | $C_{0r}$ | Grease | Oil |
| **35.717** | 72.233 | 25.400 | 25.400 | 19.842 | 3.5 | 2.3 | 63 500 | 83 500 | 5 000 | 7 100 |
| **36.487** | 73.025 | 23.812 | 24.608 | 19.050 | 1.5 | 0.8 | 71 000 | 86 000 | 5 300 | 7 100 |
| **36.512** | 76.200 | 29.370 | 28.575 | 23.020 | 3.5 | 3.3 | 78 500 | 106 000 | 4 800 | 6 700 |
| | 79.375 | 29.370 | 29.771 | 23.812 | 0.8 | 3.3 | 88 000 | 106 000 | 4 800 | 6 700 |
| | 88.501 | 25.400 | 23.698 | 17.462 | 2.3 | 1.5 | 73 000 | 81 000 | 4 000 | 5 600 |
| | 93.662 | 31.750 | 31.750 | 26.195 | 1.5 | 3.3 | 110 000 | 142 000 | 4 000 | 5 600 |
| **38.000** | 63.000 | 17.000 | 17.000 | 13.500 | spec. | 1.3 | 38 500 | 52 000 | 5 600 | 7 500 |
| **38.100** | 63.500 | 12.700 | 11.908 | 9.525 | 1.5 | 0.8 | 24 100 | 30 500 | 5 300 | 7 100 |
| | 65.088 | 18.034 | 18.288 | 13.970 | 2.3 | 1.3 | 42 500 | 55 000 | 5 300 | 7 500 |
| | 65.088 | 18.034 | 18.288 | 13.970 | spec. | 1.3 | 42 500 | 55 000 | 5 300 | 7 500 |
| | 65.088 | 19.812 | 18.288 | 15.748 | 2.3 | 1.3 | 42 500 | 55 000 | 5 300 | 7 500 |
| | 68.262 | 15.875 | 16.520 | 11.908 | 1.5 | 1.5 | 45 000 | 53 500 | 5 300 | 7 100 |
| | 69.012 | 19.050 | 19.050 | 15.083 | 2.0 | 2.3 | 49 000 | 61 000 | 5 300 | 7 100 |
| | 69.012 | 19.050 | 19.050 | 15.083 | 3.5 | 0.8 | 49 000 | 61 000 | 5 300 | 7 100 |
| | 72.238 | 20.638 | 20.638 | 15.875 | 3.5 | 1.3 | 48 500 | 59 500 | 5 300 | 7 100 |
| | 73.025 | 23.812 | 25.654 | 19.050 | 3.5 | 0.8 | 73 500 | 91 000 | 5 000 | 6 700 |
| | 76.200 | 23.812 | 25.654 | 19.050 | 3.5 | 3.3 | 73 500 | 91 000 | 5 000 | 6 700 |
| | 76.200 | 23.812 | 25.654 | 19.050 | 3.5 | 0.8 | 73 500 | 91 000 | 5 000 | 6 700 |
| | 79.375 | 29.370 | 29.771 | 23.812 | 3.5 | 3.3 | 88 000 | 106 000 | 4 800 | 6 700 |
| | 80.035 | 24.608 | 23.698 | 18.512 | 0.8 | 1.5 | 69 000 | 84 500 | 4 500 | 6 300 |
| | 82.550 | 29.370 | 28.575 | 23.020 | 0.8 | 3.3 | 87 000 | 117 000 | 4 500 | 6 000 |
| | 88.501 | 25.400 | 23.698 | 17.462 | 2.3 | 1.5 | 73 000 | 81 000 | 4 000 | 5 600 |
| | 88.501 | 26.988 | 29.083 | 22.225 | 3.5 | 1.5 | 96 500 | 109 000 | 4 500 | 6 000 |
| | 95.250 | 30.958 | 28.301 | 20.638 | 1.5 | 0.8 | 87 500 | 97 000 | 3 600 | 5 300 |
| **39.688** | 73.025 | 25.654 | 22.098 | 21.336 | 0.8 | 2.3 | 62 500 | 80 000 | 5 000 | 6 700 |
| | 76.200 | 23.812 | 25.654 | 19.050 | 3.5 | 3.3 | 73 500 | 91 000 | 5 000 | 6 700 |
| | 80.167 | 29.370 | 30.391 | 23.812 | 0.8 | 3.3 | 92 500 | 108 000 | 4 800 | 6 300 |
| **40.000** | 80.000 | 21.000 | 22.403 | 17.826 | 3.5 | 1.3 | 68 500 | 75 500 | 4 500 | 6 300 |
| | 80.000 | 21.000 | 22.403 | 17.826 | 0.8 | 1.3 | 68 500 | 75 500 | 4 500 | 6 300 |
| | 88.501 | 25.400 | 23.698 | 17.462 | 2.3 | 1.5 | 73 000 | 81 000 | 4 000 | 5 600 |
| **41.000** | 68.000 | 17.500 | 18.000 | 13.500 | spec. | 1.5 | 43 500 | 58 000 | 5 300 | 7 100 |
| **41.275** | 73.025 | 16.667 | 17.462 | 12.700 | 3.5 | 1.5 | 44 500 | 54 000 | 4 800 | 6 700 |
| | 73.431 | 19.558 | 19.812 | 14.732 | 3.5 | 0.8 | 54 500 | 67 000 | 4 800 | 6 700 |
| | 73.431 | 21.430 | 19.812 | 16.604 | 3.5 | 0.8 | 54 500 | 67 000 | 4 800 | 6 700 |




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | 0 | 0.4 | $Y_1$ |

## Static Equivalent Load

$P_0=0.5F_r+Y_0F_a$

When $F_r > 0.5F_r+Y_0F_a$, use $P_0=F_r$

The values of e, $Y_1$ and $Y_0$ are given in the table below.

| Bearing Numbers | | Abutment and Fillet Dimensions (mm) | | | | | | Eff. Load Centers (mm) | Constant | Axial Load Factors | | Mass (kg) approx. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Cone | Cup | | | | | | |
| CONE | CUP | $d_a$ | $d_b$ | $D_a$ | $D_b$ | $r_a$ max. | | a | e | $Y_1$ | $Y_0$ | CONE | CUP |
| HM 88648 | HM 88610 | 52 | 43 | 60 | 69 | 3.5 | 2.3 | 20.7 | 0.55 | 1.1 | 0.60 | 0.298 | 0.188 |
| 25880 | 25821 | 44 | 42 | 65 | 68 | 1.5 | 0.8 | 15.7 | 0.29 | 2.1 | 1.1 | 0.291 | 0.167 |
| HM 89449 | HM 89410 | 54 | 44.5 | 62 | 73 | 3.5 | 3.3 | 23.6 | 0.55 | 1.1 | 0.60 | 0.38 | 0.257 |
| 3479 | 3420 | 45.5 | 44.5 | 67 | 74 | 0.8 | 3.3 | 20.0 | 0.37 | 1.6 | 0.90 | 0.429 | 0.259 |
| 44143 | 44348 | 54 | 50 | 75 | 84 | 2.3 | 1.5 | 27.9 | 0.78 | 0.77 | 0.42 | 0.502 | 0.245 |
| 46143 | 46368 | 48.5 | 46.5 | 79 | 87 | 1.5 | 3.3 | 24.0 | 0.40 | 1.5 | 0.82 | 0.765 | 0.405 |
| ▲ JL 69349 | ▲ JL 69310 | 49 | 42.5 | 56 | 60 | 3.5 | 1.3 | 14.6 | 0.42 | 1.4 | 0.79 | 0.132 | 0.071 |
| 13889 | 13830 | 45 | 42.5 | 59 | 60 | 1.5 | 0.8 | 11.9 | 0.35 | 1.7 | 0.95 | 0.109 | 0.046 |
| LM 29749 | LM 29710 | 46 | 42.5 | 59 | 62 | 2.3 | 1.3 | 13.7 | 0.33 | 1.8 | 0.99 | 0.16 | 0.079 |
| LM 29748 | LM 29710 | 49 | 42.5 | 59 | 62 | 3.5 | 1.3 | 13.7 | 0.33 | 1.8 | 0.99 | 0.158 | 0.079 |
| LM 29749 | LM 29711 | 46 | 42.5 | 58 | 62 | 2.3 | 1.3 | 15.5 | 0.33 | 1.8 | 0.99 | 0.16 | 0.094 |
| 19150 | 19268 | 45 | 43 | 61 | 65 | 1.5 | 1.5 | 14.5 | 0.44 | 1.4 | 0.74 | 0.173 | 0.073 |
| 13687 | 13621 | 46.5 | 43 | 61 | 65 | 2 | 2.3 | 15.8 | 0.40 | 1.5 | 0.82 | 0.193 | 0.104 |
| 13685 | 13620 | 49.5 | 43 | 62 | 65 | 3.5 | 0.8 | 15.8 | 0.40 | 1.5 | 0.82 | 0.191 | 0.105 |
| 16150 | 16284 | 49.5 | 43 | 63 | 67 | 3.5 | 1.3 | 16.0 | 0.40 | 1.5 | 0.82 | 0.212 | 0.146 |
| 2788 | 2735 X | 50 | 43.5 | 66 | 69 | 3.5 | 0.8 | 15.9 | 0.30 | 2.0 | 1.1 | 0.312 | 0.135 |
| 2788 | 2720 | 50 | 43.5 | 66 | 70 | 3.5 | 3.3 | 15.9 | 0.30 | 2.0 | 1.1 | 0.312 | 0.187 |
| 2788 | 2729 | 50 | 43.5 | 68 | 70 | 3.5 | 0.8 | 15.9 | 0.30 | 2.0 | 1.1 | 0.312 | 0.191 |
| 3490 | 3420 | 52 | 45.5 | 67 | 74 | 3.5 | 3.3 | 20.0 | 0.37 | 1.6 | 0.90 | 0.404 | 0.259 |
| 27880 | 27820 | 48 | 47 | 68 | 75 | 0.8 | 1.5 | 21.5 | 0.56 | 1.1 | 0.59 | 0.362 | 0.209 |
| HM 801346 | HM 801310 | 51 | 49 | 68 | 78 | 0.8 | 3.3 | 24.2 | 0.55 | 1.1 | 0.60 | 0.483 | 0.282 |
| 44150 | 44348 | 55 | 51 | 75 | 84 | 2.3 | 1.5 | 27.9 | 0.78 | 0.77 | 0.42 | 0.484 | 0.245 |
| 418 | 414 | 51 | 44.5 | 77 | 80 | 3.5 | 1.5 | 17.1 | 0.26 | 2.3 | 1.3 | 0.50 | 0.329 |
| 53150 | 53375 | 55 | 53 | 81 | 89 | 1.5 | 0.8 | 30.7 | 0.74 | 0.81 | 0.45 | 0.665 | 0.365 |
| M 201047 | M 201011 | 45.5 | 48 | 64 | 69 | 0.8 | 2.3 | 19.7 | 0.33 | 1.8 | 0.99 | 0.266 | 0.169 |
| 2789 | 2720 | 52 | 45 | 66 | 70 | 3.5 | 3.3 | 15.9 | 0.30 | 2.0 | 1.1 | 0.292 | 0.187 |
| 3386 | 3320 | 46.5 | 45.5 | 70 | 75 | 0.8 | 3.3 | 18.4 | 0.27 | 2.2 | 1.2 | 0.442 | 0.217 |
| 344 | 332 | 52 | 45.5 | 73 | 75 | 3.5 | 1.3 | 14.5 | 0.27 | 2.2 | 1.2 | 0.338 | 0.146 |
| 344 A | 332 | 46 | 45.5 | 73 | 75 | 0.8 | 1.3 | 14.5 | 0.27 | 2.2 | 1.2 | 0.339 | 0.146 |
| 44157 | 44348 | 56 | 51 | 75 | 84 | 2.3 | 1.5 | 27.9 | 0.78 | 0.77 | 0.42 | 0.463 | 0.245 |
| * LM 300849 | ** LM 300811 | 52 | 45 | 61 | 65 | 3.5 | 1.5 | 13.9 | 0.35 | 1.7 | 0.95 | 0.16 | 0.082 |
| 18590 | 18520 | 53 | 46 | 66 | 69 | 3.5 | 1.5 | 14.0 | 0.35 | 1.7 | 0.94 | 0.199 | 0.086 |
| LM 501349 | LM 501310 | 53 | 46.5 | 67 | 70 | 3.5 | 0.8 | 16.3 | 0.40 | 1.5 | 0.83 | 0.226 | 0.108 |
| LM 501349 | LM 501314 | 53 | 46.5 | 66 | 70 | 3.5 | 0.8 | 18.2 | 0.40 | 1.5 | 0.83 | 0.226 | 0.129 |

**Notes**

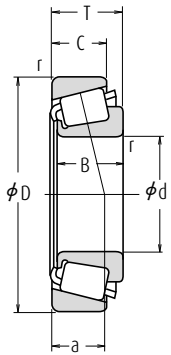
* The maximum bore diameter is listed and its tolerance is negative (See Table **7.4.1** on Page **A136**).

** The maximum outside diameter is listed and its tolerance is negative (See Table **7.4.2** on Pages **A136** and **A137**).

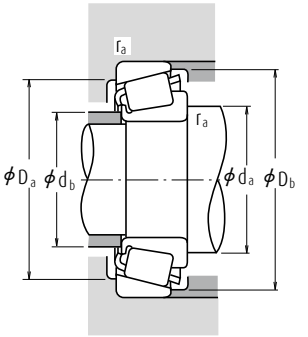
▲ The tolerances are listed in Tables **2, 3** and **4** on Pages **B202** and **B203**.

# Single-Row Tapered Roller Bearings (Inch Design)

## Bore Diameter 41.275 – 44.450 mm




| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Limiting Speeds ($min^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cone | Cup | | | | |
| d | D | T | B | C | r min. | | $C_r$ | $C_{0r}$ | Grease | Oil |
| **41.275** | 76.200 | 18.009 | 17.384 | 14.288 | 1.5 | 1.5 | 42 500 | 51 000 | 4 500 | 6 300 |
| | 76.200 | 22.225 | 23.020 | 17.462 | 3.5 | 0.8 | 66 000 | 82 000 | 4 800 | 6 700 |
| | 76.200 | 25.400 | 23.020 | 20.638 | 3.5 | 2.3 | 66 000 | 82 000 | 4 800 | 6 700 |
| | 79.375 | 23.812 | 25.400 | 19.050 | 3.5 | 0.8 | 77 000 | 98 500 | 4 800 | 6 300 |
| | 80.000 | 21.000 | 22.403 | 17.826 | 0.8 | 1.3 | 68 500 | 75 500 | 4 500 | 6 300 |
| | 80.000 | 21.000 | 22.403 | 17.826 | 3.5 | 1.3 | 68 500 | 75 500 | 4 500 | 6 300 |
| | 80.167 | 25.400 | 25.400 | 20.638 | 3.5 | 3.3 | 77 000 | 98 500 | 4 800 | 6 300 |
| | 82.550 | 26.543 | 25.654 | 20.193 | 3.5 | 3.3 | 78 500 | 102 000 | 4 300 | 6 000 |
| | 85.725 | 30.162 | 30.162 | 23.812 | 3.5 | 3.3 | 91 000 | 115 000 | 4 300 | 6 000 |
| | 87.312 | 30.162 | 30.886 | 23.812 | 0.8 | 3.3 | 96 000 | 120 000 | 4 300 | 6 000 |
| | 88.501 | 25.400 | 23.698 | 17.462 | 2.3 | 1.5 | 69 000 | 75 500 | 4 000 | 5 600 |
| | 88.900 | 30.162 | 29.370 | 23.020 | 3.5 | 3.3 | 96 500 | 129 000 | 4 000 | 5 600 |
| | 88.900 | 30.162 | 29.370 | 23.020 | 0.8 | 3.3 | 96 500 | 129 000 | 4 000 | 5 600 |
| | 90.488 | 39.688 | 40.386 | 33.338 | 3.5 | 3.3 | 139 000 | 180 000 | 4 300 | 5 600 |
| | 93.662 | 31.750 | 31.750 | 26.195 | 0.8 | 3.3 | 110 000 | 142 000 | 4 000 | 5 600 |
| | 95.250 | 30.162 | 29.370 | 23.020 | 3.5 | 3.3 | 106 000 | 143 000 | 3 800 | 5 300 |
| | 98.425 | 30.958 | 28.301 | 20.638 | 1.5 | 0.8 | 87 500 | 97 000 | 3 600 | 5 300 |
| **42.862** | 76.992 | 17.462 | 17.145 | 11.908 | 1.5 | 1.5 | 44 000 | 54 000 | 4 500 | 6 000 |
| | 82.550 | 19.842 | 19.837 | 15.080 | 2.3 | 1.5 | 58 500 | 69 000 | 4 500 | 6 300 |
| | 82.931 | 23.812 | 25.400 | 19.050 | 2.3 | 0.8 | 76 500 | 99 000 | 4 500 | 6 000 |
| | 82.931 | 26.988 | 25.400 | 22.225 | 2.3 | 2.3 | 76 500 | 99 000 | 4 500 | 6 000 |
| **42.875** | 76.200 | 25.400 | 25.400 | 20.638 | 3.5 | 1.5 | 77 000 | 98 500 | 4 800 | 6 300 |
| | 80.000 | 21.000 | 22.403 | 17.826 | 3.5 | 1.3 | 68 500 | 75 500 | 4 500 | 6 300 |
| | 82.931 | 26.988 | 25.400 | 22.225 | 3.5 | 2.3 | 76 500 | 99 000 | 4 500 | 6 000 |
| | 83.058 | 23.812 | 25.400 | 19.050 | 3.5 | 3.3 | 76 500 | 99 000 | 4 500 | 6 000 |
| **43.000** | 74.988 | 19.368 | 19.837 | 14.288 | 1.5 | 1.3 | 52 500 | 68 000 | 4 800 | 6 300 |
| **44.450** | 80.962 | 19.050 | 17.462 | 14.288 | 0.3 | 1.5 | 45 000 | 57 000 | 4 300 | 6 000 |
| | 82.931 | 23.812 | 25.400 | 19.050 | 3.5 | 0.8 | 76 500 | 99 000 | 4 500 | 6 000 |
| | 83.058 | 23.812 | 25.400 | 19.050 | 3.5 | 3.3 | 76 500 | 99 000 | 4 500 | 6 000 |
| | 87.312 | 30.162 | 30.886 | 23.812 | 3.5 | 3.3 | 96 000 | 120 000 | 4 300 | 6 000 |
| | 88.900 | 30.162 | 29.370 | 23.020 | 3.5 | 3.3 | 96 500 | 129 000 | 4 000 | 5 600 |
| | 93.264 | 30.162 | 30.302 | 23.812 | 3.5 | 3.2 | 103 000 | 136 000 | 3 800 | 5 300 |
| | 93.662 | 31.750 | 31.750 | 25.400 | 0.8 | 3.3 | 120 000 | 147 000 | 4 000 | 5 600 |
| | 93.662 | 31.750 | 31.750 | 25.400 | 3.5 | 3.3 | 120 000 | 147 000 | 4 000 | 5 600 |
| | 93.662 | 31.750 | 31.750 | 26.195 | 3.5 | 3.3 | 110 000 | 142 000 | 4 000 | 5 600 |
| | 95.250 | 27.783 | 29.901 | 22.225 | 3.5 | 2.3 | 106 000 | 126 000 | 4 300 | 5 600 |




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | 0 | 0.4 | $Y_1$ |

## Static Equivalent Load

$P_0=0.5F_r+Y_0F_a$

When $F_r>0.5F_r+Y_0F_a$, use $P_0=F_r$

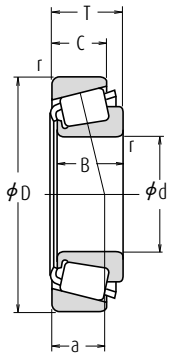
The values of e, $Y_1$ and $Y_0$ are given in the table below.

| Bearing Numbers | | Abutment and Fillet Dimensions (mm) | | | | | | Eff. Load Centers (mm) | Constant | Axial Load Factors | | Mass (kg) approx. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Cone | Cup | | | | | | |
| CONE | CUP | $d_a$ | $d_b$ | $D_a$ | $D_b$ | $r_a$ max. | | a | e | $Y_1$ | $Y_0$ | CONE | CUP |
| 11162 | 11300 | 49 | 46.5 | 67 | 71 | 1.5 | 1.5 | 17.4 | 0.49 | 1.2 | 0.68 | 0.212 | 0.129 |
| 24780 | 24720 | 53 | 47.5 | 68 | 72 | 3.5 | 0.8 | 17.0 | 0.39 | 1.5 | 0.84 | 0.279 | 0.15 |
| 24780 | 24721 | 54 | 47 | 66 | 72 | 3.5 | 2.3 | 20.2 | 0.39 | 1.5 | 0.84 | 0.279 | 0.189 |
| 26882 | 26822 | 54 | 47 | 71 | 74 | 3.5 | 0.8 | 16.4 | 0.32 | 1.9 | 1.0 | 0.349 | 0.186 |
| 336 | 332 | 47 | 46 | 73 | 75 | 0.8 | 1.3 | 14.5 | 0.27 | 2.2 | 1.2 | 0.325 | 0.146 |
| 342 | 332 | 53 | 46 | 73 | 75 | 3.5 | 1.3 | 14.5 | 0.27 | 2.2 | 1.2 | 0.323 | 0.146 |
| 26882 | 26820 | 54 | 47 | 69 | 74 | 3.5 | 3.3 | 18.0 | 0.32 | 1.9 | 1.0 | 0.349 | 0.219 |
| M 802048 | M 802011 | 57 | 51 | 70 | 79 | 3.5 | 3.3 | 22.9 | 0.55 | 1.1 | 0.60 | 0.406 | 0.23 |
| 3877 | 3820 | 57 | 50 | 73 | 81 | 3.5 | 3.3 | 21.8 | 0.40 | 1.5 | 0.82 | 0.506 | 0.285 |
| 3576 | 3525 | 49 | 48 | 75 | 81 | 0.8 | 3.3 | 19.5 | 0.31 | 2.0 | 1.1 | 0.532 | 0.304 |
| 44162 | 44348 | 57 | 51 | 75 | 84 | 2.3 | 1.5 | 28.0 | 0.78 | 0.77 | 0.42 | 0.447 | 0.245 |
| HM 803146 | HM 803110 | 60 | 53 | 74 | 85 | 3.5 | 3.3 | 25.6 | 0.55 | 1.1 | 0.60 | 0.579 | 0.322 |
| HM 803145 | HM 803110 | 54 | 53 | 74 | 85 | 0.8 | 3.3 | 25.6 | 0.55 | 1.1 | 0.60 | 0.582 | 0.322 |
| 4388 | 4335 | 57 | 51 | 77 | 85 | 3.5 | 3.3 | 24.6 | 0.28 | 2.1 | 1.2 | 0.789 | 0.459 |
| 46162 | 46368 | 52 | 51 | 79 | 87 | 0.8 | 3.3 | 24.0 | 0.40 | 1.5 | 0.82 | 0.695 | 0.405 |
| HM 804840 | HM 804810 | 61 | 54 | 81 | 91 | 3.5 | 3.3 | 26.1 | 0.55 | 1.1 | 0.60 | 0.726 | 0.354 |
| 53162 | 53387 | 57 | 53 | 82 | 91 | 1.5 | 0.8 | 30.7 | 0.74 | 0.81 | 0.45 | 0.618 | 0.442 |
| 12168 | 12303 | 51 | 48.5 | 68 | 73 | 1.5 | 1.5 | 17.7 | 0.51 | 1.2 | 0.65 | 0.228 | 0.098 |
| 22168 | 22325 | 52 | 48.5 | 73 | 76 | 2.3 | 1.5 | 17.6 | 0.43 | 1.4 | 0.77 | 0.283 | 0.176 |
| 25578 | 25520 | 53 | 49.5 | 74 | 77 | 2.3 | 0.8 | 17.6 | 0.33 | 1.8 | 0.99 | 0.383 | 0.203 |
| 25578 | 25523 | 53 | 49.5 | 72 | 77 | 2.3 | 2.3 | 20.8 | 0.33 | 1.8 | 0.99 | 0.383 | 0.248 |
| 26884 | 26823 | 55 | 48.5 | 69 | 73 | 3.5 | 1.5 | 18.0 | 0.32 | 1.9 | 1.0 | 0.337 | 0.136 |
| 342 S | 332 | 54 | 47.5 | 73 | 75 | 3.5 | 1.3 | 14.5 | 0.27 | 2.2 | 1.2 | 0.305 | 0.146 |
| 25577 | 25523 | 55 | 49 | 72 | 77 | 3.5 | 2.3 | 20.8 | 0.33 | 1.8 | 0.99 | 0.381 | 0.248 |
| 25577 | 25521 | 55 | 49 | 72 | 77 | 3.5 | 3.3 | 17.6 | 0.33 | 1.8 | 0.99 | 0.381 | 0.201 |
| * 16986 | 16929 | 51 | 48.5 | 67 | 71 | 1.5 | 1.3 | 17.2 | 0.44 | 1.4 | 0.74 | 0.24 | 0.106 |
| 13175 | 13318 | 50 | 50 | 72 | 76 | 0.3 | 1.5 | 20.1 | 0.53 | 1.1 | 0.63 | 0.252 | 0.144 |
| 25580 | 25520 | 57 | 50 | 74 | 77 | 3.5 | 0.8 | 17.6 | 0.33 | 1.8 | 0.99 | 0.359 | 0.203 |
| 25580 | 25521 | 56 | 51 | 72 | 78 | 3.5 | 3.3 | 17.6 | 0.33 | 1.8 | 0.99 | 0.359 | 0.201 |
| 3578 | 3525 | 57 | 51 | 75 | 81 | 3.5 | 3.3 | 19.5 | 0.31 | 2.0 | 1.1 | 0.477 | 0.304 |
| HM 803149 | HM 803110 | 62 | 53 | 74 | 85 | 3.5 | 3.3 | 25.6 | 0.55 | 1.1 | 0.60 | 0.528 | 0.322 |
| 3782 | 3720 | 58 | 52 | 82 | 88 | 3.5 | 3.2 | 22.4 | 0.34 | 1.8 | 0.97 | 0.678 | 0.292 |
| 49176 | 49368 | 54 | 53 | 82 | 87 | 0.8 | 3.3 | 21.6 | 0.36 | 1.7 | 0.92 | 0.648 | 0.371 |
| 49175 | 49368 | 59 | 53 | 82 | 87 | 3.5 | 3.3 | 21.6 | 0.36 | 1.7 | 0.92 | 0.645 | 0.371 |
| 46176 | 46368 | 60 | 54 | 79 | 87 | 3.5 | 3.3 | 24.0 | 0.40 | 1.5 | 0.82 | 0.635 | 0.405 |
| 438 | 432 | 57 | 51 | 83 | 87 | 3.5 | 2.3 | 18.6 | 0.28 | 2.1 | 1.2 | 0.555 | 0.384 |

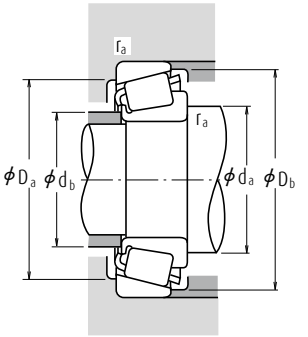
Note * The maximum bore diameter is listed and its tolerance is negative (See Table **7.4.1** on Page **A136**).

# Single-Row Tapered Roller Bearings (Inch Design)

## Bore Diameter 44.450 – 47.625 mm




| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Limiting Speeds ($min^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cone | Cup | | | | |
| d | D | T | B | C | r min. | | $C_r$ | $C_{0r}$ | Grease | Oil |
| **44.450** | 95.250 | 30.162 | 29.370 | 23.020 | 3.5 | 3.3 | 106 000 | 143 000 | 3 800 | 5 300 |
| | 95.250 | 30.958 | 28.301 | 20.638 | 3.5 | 0.8 | 87 500 | 97 000 | 3 600 | 5 300 |
| | 95.250 | 30.958 | 28.301 | 20.638 | 1.3 | 0.8 | 87 500 | 97 000 | 3 600 | 5 300 |
| | 95.250 | 30.958 | 28.301 | 20.638 | 2.0 | 0.8 | 87 500 | 97 000 | 3 600 | 5 300 |
| | 95.250 | 30.958 | 28.301 | 22.225 | 1.3 | 0.8 | 100 000 | 122 000 | 3 600 | 5 000 |
| | 95.250 | 30.958 | 28.575 | 22.225 | 3.5 | 0.8 | 100 000 | 122 000 | 3 600 | 5 000 |
| | 98.425 | 30.958 | 28.301 | 20.638 | 3.5 | 0.8 | 87 500 | 97 000 | 3 600 | 5 300 |
| | 103.188 | 43.658 | 44.475 | 36.512 | 1.3 | 3.3 | 178 000 | 238 000 | 3 800 | 5 000 |
| | 104.775 | 36.512 | 36.512 | 28.575 | 3.5 | 3.3 | 139 000 | 192 000 | 3 400 | 4 800 |
| | 107.950 | 27.783 | 29.317 | 22.225 | 3.5 | 0.8 | 116 000 | 149 000 | 3 400 | 4 800 |
| | 111.125 | 30.162 | 26.909 | 20.638 | 3.5 | 3.3 | 92 500 | 110 000 | 3 200 | 4 300 |
| | 114.300 | 44.450 | 44.450 | 34.925 | 3.5 | 3.3 | 172 000 | 205 000 | 3 600 | 4 800 |
| **44.983** | 82.931 | 23.812 | 25.400 | 19.050 | 1.5 | 0.8 | 76 500 | 99 000 | 4 500 | 6 000 |
| **45.000** | 93.264 | 20.638 | 22.225 | 15.082 | 0.8 | 1.3 | 77 000 | 93 000 | 3 800 | 5 300 |
| **45.230** | 79.985 | 19.842 | 20.638 | 15.080 | 2.0 | 1.3 | 62 000 | 78 500 | 4 500 | 6 000 |
| **45.242** | 73.431 | 19.558 | 19.812 | 15.748 | 3.5 | 0.8 | 53 500 | 75 000 | 4 800 | 6 300 |
| | 77.788 | 19.842 | 19.842 | 15.080 | 3.5 | 0.8 | 56 000 | 71 000 | 4 500 | 6 300 |
| | 77.788 | 21.430 | 19.842 | 16.667 | 3.5 | 0.8 | 56 000 | 71 000 | 4 500 | 6 300 |
| **45.618** | 82.931 | 23.812 | 25.400 | 19.050 | 3.5 | 0.8 | 76 500 | 99 000 | 4 500 | 6 000 |
| | 82.931 | 26.988 | 25.400 | 22.225 | 3.5 | 2.3 | 76 500 | 99 000 | 4 500 | 6 000 |
| **46.000** | 75.000 | 18.000 | 18.000 | 14.000 | 2.3 | 1.5 | 51 000 | 71 500 | 4 500 | 6 300 |
| **46.038** | 79.375 | 17.462 | 17.462 | 13.495 | 2.8 | 1.5 | 46 000 | 57 000 | 4 500 | 6 000 |
| | 80.962 | 19.050 | 17.462 | 14.288 | 0.8 | 1.5 | 45 000 | 57 000 | 4 300 | 6 000 |
| | 85.000 | 20.638 | 21.692 | 17.462 | 2.3 | 1.3 | 71 500 | 81 500 | 4 300 | 6 000 |
| | 85.000 | 25.400 | 25.608 | 20.638 | 3.5 | 1.3 | 79 500 | 105 000 | 4 300 | 6 000 |
| | 95.250 | 27.783 | 29.901 | 22.225 | 3.5 | 0.8 | 106 000 | 126 000 | 4 300 | 5 600 |
| **47.625** | 88.900 | 20.638 | 22.225 | 16.513 | 3.5 | 1.3 | 73 000 | 85 000 | 4 000 | 5 600 |
| | 88.900 | 25.400 | 25.400 | 19.050 | 3.5 | 3.3 | 86 000 | 107 000 | 4 000 | 5 600 |
| | 95.250 | 30.162 | 29.370 | 23.020 | 3.5 | 3.3 | 106 000 | 143 000 | 3 800 | 5 300 |
| | 101.600 | 34.925 | 36.068 | 26.988 | 3.5 | 3.3 | 137 000 | 169 000 | 3 800 | 5 000 |
| | 111.125 | 30.162 | 26.909 | 20.638 | 3.5 | 3.3 | 92 500 | 110 000 | 3 200 | 4 300 |
| | 112.712 | 30.162 | 26.909 | 20.638 | 3.5 | 3.3 | 92 500 | 110 000 | 3 200 | 4 300 |
| | 117.475 | 33.338 | 31.750 | 23.812 | 3.5 | 3.3 | 137 000 | 156 000 | 3 200 | 4 300 |
| | 123.825 | 36.512 | 32.791 | 25.400 | 3.5 | 3.3 | 143 000 | 160 000 | 3 000 | 4 000 |




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | 0 | 0.4 | $Y_1$ |

## Static Equivalent Load

$P_0=0.5F_r+Y_0F_a$

When $F_r>0.5F_r+Y_0F_a$, use $P_0=F_r$

The values of e, $Y_1$ and $Y_0$ are given in the table below.

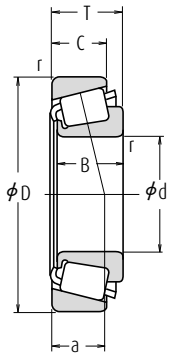
| Bearing Numbers | | Abutment and Fillet Dimensions (mm) | | | | | | Eff. Load Centers (mm) | Constant | Axial Load Factors | | Mass (kg) approx. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Cone | Cup | | | | | | |
| CONE | CUP | $d_a$ | $d_b$ | $D_a$ | $D_b$ | $r_a$ max. | | a | e | $Y_1$ | $Y_0$ | CONE | CUP |
| HM 804843 | HM 804810 | 63 | 57 | 81 | 91 | 3.5 | 3.3 | 26.1 | 0.55 | 1.1 | 0.60 | 0.677 | 0.354 |
| 53177 | 53375 | 63 | 53 | 81 | 89 | 3.5 | 0.8 | 30.7 | 0.74 | 0.81 | 0.45 | 0.572 | 0.365 |
| 53176 | 53375 | 59 | 53 | 81 | 89 | 1.3 | 0.8 | 30.7 | 0.74 | 0.81 | 0.45 | 0.574 | 0.365 |
| 53178 | 53375 | 60 | 53 | 81 | 89 | 2 | 0.8 | 30.7 | 0.74 | 0.81 | 0.45 | 0.574 | 0.365 |
| HM 903247 | HM 903210 | 61 | 54 | 81 | 91 | 1.3 | 0.8 | 31.5 | 0.74 | 0.81 | 0.45 | 0.651 | 0.389 |
| HM 903249 | HM 903210 | 65 | 54 | 81 | 91 | 3.5 | 0.8 | 31.5 | 0.74 | 0.81 | 0.45 | 0.635 | 0.389 |
| 53177 | 53387 | 63 | 53 | 82 | 91 | 3.5 | 0.8 | 30.7 | 0.74 | 0.81 | 0.45 | 0.568 | 0.442 |
| 5356 | 5335 | 58 | 56 | 89 | 97 | 1.3 | 3.3 | 27.0 | 0.30 | 2.0 | 1.1 | 1.23 | 0.637 |
| HM 807040 | HM 807010 | 66 | 59 | 89 | 100 | 3.5 | 3.3 | 29.7 | 0.49 | 1.2 | 0.68 | 1.14 | 0.502 |
| 460 | 453 A | 60 | 54 | 97 | 100 | 3.5 | 0.8 | 20.7 | 0.34 | 1.8 | 0.98 | 0.93 | 0.42 |
| 55175 | 55437 | 67 | 60 | 92 | 105 | 3.5 | 3.3 | 37.3 | 0.88 | 0.68 | 0.37 | 0.867 | 0.514 |
| 65385 | 65320 | 65 | 59 | 97 | 107 | 3.5 | 3.3 | 32.2 | 0.43 | 1.4 | 0.77 | 1.39 | 0.894 |
| 25584 | 25520 | 53 | 51 | 74 | 77 | 1.5 | 0.8 | 17.6 | 0.33 | 1.8 | 0.99 | 0.354 | 0.203 |
| 376 | 374 | 54 | 54 | 85 | 88 | 0.8 | 1.3 | 17.1 | 0.34 | 1.8 | 0.97 | 0.492 | 0.174 |
| 17887 | 17831 | 57 | 52 | 68 | 74 | 2 | 1.3 | 15.9 | 0.37 | 1.6 | 0.90 | 0.274 | 0.136 |
| LM 102949 | LM 102910 | 56 | 50 | 68 | 70 | 3.5 | 0.8 | 14.6 | 0.31 | 2.0 | 1.1 | 0.213 | 0.102 |
| LM 603049 | LM 603011 | 57 | 50 | 71 | 74 | 3.5 | 0.8 | 17.2 | 0.43 | 1.4 | 0.77 | 0.249 | 0.119 |
| LM 603049 | LM 603012 | 57 | 50 | 70 | 74 | 3.5 | 0.8 | 18.8 | 0.43 | 1.4 | 0.77 | 0.249 | 0.137 |
| 25590 | 25520 | 58 | 51 | 74 | 77 | 3.5 | 0.8 | 17.6 | 0.33 | 1.8 | 0.99 | 0.343 | 0.203 |
| 25590 | 25523 | 58 | 51 | 72 | 77 | 3.5 | 2.3 | 20.8 | 0.33 | 1.8 | 0.99 | 0.343 | 0.248 |
| * LM 503349 | ** LM 503310 | 55 | 51 | 67 | 71 | 2.3 | 1.5 | 15.9 | 0.40 | 1.5 | 0.82 | 0.209 | 0.096 |
| 18690 | 18620 | 56 | 51 | 71 | 74 | 2.8 | 1.5 | 15.5 | 0.37 | 1.6 | 0.88 | 0.211 | 0.126 |
| 13181 | 13318 | 52 | 52 | 72 | 76 | 0.8 | 1.5 | 20.1 | 0.53 | 1.1 | 0.63 | 0.236 | 0.144 |
| 359 S | 354 A | 55 | 51 | 77 | 80 | 2.3 | 1.3 | 15.4 | 0.31 | 2.0 | 1.1 | 0.343 | 0.162 |
| 2984 | 2924 | 58 | 52 | 76 | 80 | 3.5 | 1.3 | 19.0 | 0.35 | 1.7 | 0.95 | 0.397 | 0.223 |
| 436 | 432 A | 59 | 52 | 84 | 87 | 3.5 | 0.8 | 18.6 | 0.28 | 2.1 | 1.2 | 0.536 | 0.381 |
| 369 A | 362 A | 60 | 53 | 81 | 84 | 3.5 | 1.3 | 16.6 | 0.32 | 1.9 | 1.0 | 0.381 | 0.166 |
| M 804049 | M 804010 | 63 | 56 | 77 | 85 | 3.5 | 3.3 | 23.8 | 0.55 | 1.1 | 0.60 | 0.455 | 0.218 |
| HM 804846 | HM 804810 | 66 | 57 | 81 | 91 | 3.5 | 3.3 | 26.1 | 0.55 | 1.1 | 0.60 | 0.626 | 0.354 |
| 528 | 522 | 62 | 55 | 89 | 95 | 3.5 | 3.3 | 22.1 | 0.29 | 2.1 | 1.2 | 0.894 | 0.416 |
| 55187 | 55437 | 69 | 62 | 92 | 105 | 3.5 | 3.3 | 37.3 | 0.88 | 0.68 | 0.37 | 0.817 | 0.514 |
| 55187 | 55443 | 69 | 62 | 92 | 106 | 3.5 | 3.3 | 37.3 | 0.88 | 0.68 | 0.37 | 0.816 | 0.554 |
| 66187 | 66462 | 66 | 62 | 100 | 111 | 3.5 | 3.3 | 32.1 | 0.63 | 0.96 | 0.53 | 1.19 | 0.552 |
| 72187 | 72487 | 72 | 66 | 102 | 116 | 3.5 | 3.3 | 37.0 | 0.74 | 0.81 | 0.45 | 1.29 | 0.79 |

**Notes** * The maximum bore diameter is listed and its tolerance is negative (See Table **7.4.1** on Page **A136**).

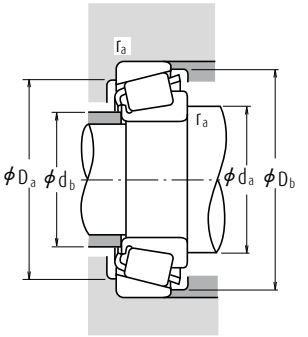
** The maximum outside diameter is listed and its tolerance is negative (See Table **7.4.2** on Pages **A136** and **A137**).

# Single-Row Tapered Roller Bearings (Inch Design)

## Bore Diameter 48.412 – 52.388 mm




| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Limiting Speeds (min$^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cone | Cup | | | | |
| d | D | T | B | C | r min. | | $C_r$ | $C_{0r}$ | Grease | Oil |
| **48.412** | 95.250 | 30.162 | 29.370 | 23.020 | 3.5 | 3.3 | 106 000 | 143 000 | 3 800 | 5 300 |
| | 95.250 | 30.162 | 29.370 | 23.020 | 2.3 | 3.3 | 106 000 | 143 000 | 3 800 | 5 300 |
| **49.212** | 104.775 | 36.512 | 36.512 | 28.575 | 3.5 | 0.8 | 139 000 | 192 000 | 3 400 | 4 800 |
| | 114.300 | 44.450 | 44.450 | 36.068 | 3.5 | 3.3 | 196 000 | 243 000 | 3 400 | 4 800 |
| **50.000** | 82.000 | 21.500 | 21.500 | 17.000 | 3.0 | 0.5 | 71 000 | 96 000 | 4 300 | 5 600 |
| | 82.550 | 21.590 | 22.225 | 16.510 | 0.5 | 1.3 | 71 000 | 96 000 | 4 300 | 5 600 |
| | 88.900 | 20.638 | 22.225 | 16.513 | 2.3 | 1.3 | 73 000 | 85 000 | 4 000 | 5 600 |
| | 90.000 | 28.000 | 28.000 | 23.000 | 3.0 | 2.5 | 104 000 | 136 000 | 4 000 | 5 600 |
| | 105.000 | 37.000 | 36.000 | 29.000 | 3.0 | 2.5 | 139 000 | 192 000 | 3 400 | 4 800 |
| **50.800** | 80.962 | 18.258 | 18.258 | 14.288 | 1.5 | 1.5 | 53 000 | 81 000 | 4 300 | 5 600 |
| | 82.550 | 23.622 | 22.225 | 18.542 | 3.5 | 0.8 | 71 000 | 96 000 | 4 300 | 5 600 |
| | 82.931 | 21.590 | 22.225 | 16.510 | 3.5 | 1.3 | 71 000 | 96 000 | 4 300 | 5 600 |
| | 85.000 | 17.462 | 17.462 | 13.495 | 3.5 | 1.5 | 48 500 | 63 000 | 4 300 | 5 600 |
| | 85.725 | 19.050 | 18.263 | 12.700 | 1.5 | 1.5 | 42 500 | 54 000 | 4 000 | 5 300 |
| | 88.900 | 20.638 | 22.225 | 16.513 | 3.5 | 1.3 | 73 000 | 85 000 | 4 000 | 5 600 |
| | 88.900 | 20.638 | 22.225 | 16.513 | 1.5 | 1.3 | 73 000 | 85 000 | 4 000 | 5 600 |
| | 92.075 | 24.608 | 25.400 | 19.845 | 3.5 | 0.8 | 84 500 | 117 000 | 4 000 | 5 300 |
| | 93.264 | 30.162 | 30.302 | 23.812 | 0.8 | 0.8 | 103 000 | 136 000 | 3 800 | 5 300 |
| | 93.264 | 30.162 | 30.302 | 23.812 | 3.5 | 0.8 | 103 000 | 136 000 | 3 800 | 5 300 |
| | 95.250 | 27.783 | 28.575 | 22.225 | 3.5 | 2.3 | 110 000 | 144 000 | 3 800 | 5 300 |
| | 101.600 | 31.750 | 31.750 | 25.400 | 3.5 | 3.3 | 118 000 | 150 000 | 3 600 | 5 000 |
| | 101.600 | 34.925 | 36.068 | 26.988 | 0.8 | 3.3 | 137 000 | 169 000 | 3 800 | 5 000 |
| | 101.600 | 34.925 | 36.068 | 26.988 | 3.5 | 3.3 | 137 000 | 169 000 | 3 800 | 5 000 |
| | 104.775 | 36.512 | 36.512 | 28.575 | 3.5 | 0.8 | 139 000 | 192 000 | 3 400 | 4 800 |
| | 104.775 | 36.512 | 36.512 | 28.575 | 3.5 | 3.3 | 139 000 | 192 000 | 3 400 | 4 800 |
| | 108.966 | 34.925 | 36.512 | 26.988 | 3.5 | 3.3 | 145 000 | 181 000 | 3 600 | 4 800 |
| | 111.125 | 30.162 | 26.909 | 20.638 | 3.5 | 3.3 | 113 000 | 152 000 | 3 000 | 4 300 |
| | 111.125 | 30.162 | 26.909 | 20.638 | 3.5 | 3.3 | 92 500 | 110 000 | 3 200 | 4 300 |
| | 123.825 | 36.512 | 32.791 | 25.400 | 3.5 | 3.3 | 162 000 | 199 000 | 2 800 | 4 000 |
| | 123.825 | 36.512 | 32.791 | 25.400 | 3.5 | 3.3 | 143 000 | 160 000 | 3 000 | 4 000 |
| | 127.000 | 44.450 | 44.450 | 34.925 | 3.5 | 3.3 | 199 000 | 258 000 | 3 000 | 4 000 |
| | 127.000 | 50.800 | 52.388 | 41.275 | 3.5 | 3.3 | 236 000 | 300 000 | 3 200 | 4 300 |
| **52.388** | 92.075 | 24.608 | 25.400 | 19.845 | 3.5 | 0.8 | 84 500 | 117 000 | 4 000 | 5 300 |
| | 100.000 | 25.000 | 22.225 | 21.824 | 2.3 | 2.0 | 77 000 | 93 000 | 3 800 | 5 300 |
| | 111.125 | 30.162 | 26.909 | 20.638 | 3.5 | 3.3 | 92 500 | 110 000 | 3 200 | 4 300 |




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | 0 | 0.4 | $Y_1$ |

## Static Equivalent Load

$P_0=0.5F_r+Y_0F_a$

When $F_r>0.5F_r+Y_0F_a$, use $P_0=F_r$

The values of e, $Y_1$ and $Y_0$ are given in the table below.

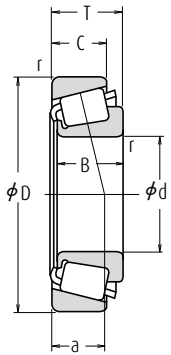
| Bearing Numbers | | Abutment and Fillet Dimensions (mm) | | | | | | Eff. Load Centers (mm) | Constant | Axial Load Factors | | Mass (kg) approx. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Cone | Cup | | | | | | |
| CONE | CUP | $d_a$ | $d_b$ | $D_a$ | $D_b$ | $r_a$ max. | | a | e | $Y_1$ | $Y_0$ | CONE | CUP |
| HM 804849 | HM 804810 | 66 | 57 | 81 | 91 | 3.5 | 3.3 | 26.1 | 0.55 | 1.1 | 0.60 | 0.61 | 0.354 |
| HM 804848 | HM 804810 | 63 | 57 | 81 | 91 | 2.3 | 3.3 | 26.1 | 0.55 | 1.1 | 0.60 | 0.614 | 0.354 |
| HM 807044 | HM 807011 | 69 | 63 | 91 | 100 | 3.5 | 0.8 | 29.7 | 0.49 | 1.2 | 0.68 | 1.03 | 0.508 |
| HH 506348 | HH 506310 | 71 | 61 | 97 | 107 | 3.5 | 3.3 | 30.8 | 0.40 | 1.5 | 0.82 | 1.43 | 0.837 |
| ▲ JLM 104948 | ▲ JLM 104910 | 60 | 55 | 76 | 78 | 3 | 0.5 | 16.1 | 0.31 | 2.0 | 1.1 | 0.306 | 0.129 |
| * LM 104947 A | LM 104911 | 55 | 55 | 75 | 78 | 0.5 | 1.3 | 15.7 | 0.31 | 2.0 | 1.1 | 0.316 | 0.133 |
| 366 | 362 A | 59 | 55 | 81 | 84 | 2.3 | 1.3 | 16.6 | 0.32 | 1.9 | 1.0 | 0.351 | 0.166 |
| ▲ JM 205149 | ▲ JM 205110 | 62 | 57 | 80 | 85 | 3 | 2.5 | 19.9 | 0.33 | 1.8 | 1.0 | 0.507 | 0.246 |
| ▲ JHM 807045 | ▲ JHM 807012 | 69 | 63 | 90 | 100 | 3 | 2.5 | 29.7 | 0.49 | 1.2 | 0.68 | 1.01 | 0.523 |
| L 305649 | L 305610 | 58 | 56 | 73 | 77 | 1.5 | 1.5 | 15.7 | 0.36 | 1.7 | 0.93 | 0.239 | 0.119 |
| LM 104949 | LM 104911 A | 62 | 55 | 75 | 78 | 3.5 | 0.8 | 17.8 | 0.31 | 2.0 | 1.1 | 0.303 | 0.156 |
| LM 104949 | LM 104912 | 62 | 55 | 75 | 78 | 3.5 | 1.3 | 15.7 | 0.31 | 2.0 | 1.1 | 0.301 | 0.14 |
| 18790 | 18720 | 62 | 56 | 77 | 80 | 3.5 | 1.5 | 16.7 | 0.41 | 1.5 | 0.81 | 0.239 | 0.136 |
| 18200 | 18337 | 59 | 56 | 76 | 81 | 1.5 | 1.5 | 21.0 | 0.57 | 1.1 | 0.58 | 0.268 | 0.136 |
| 368 A | 362 A | 62 | 56 | 81 | 84 | 3.5 | 1.3 | 16.6 | 0.32 | 1.9 | 1.0 | 0.338 | 0.166 |
| 368 | 362 A | 58 | 56 | 81 | 84 | 1.5 | 1.3 | 16.6 | 0.32 | 1.9 | 1.0 | 0.341 | 0.166 |
| 28580 | 28521 | 63 | 57 | 83 | 87 | 3.5 | 0.8 | 20.0 | 0.38 | 1.6 | 0.87 | 0.46 | 0.247 |
| 3775 | 3730 | 58 | 58 | 84 | 88 | 0.8 | 0.8 | 22.4 | 0.34 | 1.8 | 0.97 | 0.568 | 0.297 |
| 3780 | 3730 | 64 | 58 | 84 | 88 | 3.5 | 0.8 | 22.4 | 0.34 | 1.8 | 0.97 | 0.564 | 0.297 |
| 33889 | 33821 | 64 | 58 | 85 | 90 | 3.5 | 2.3 | 19.8 | 0.33 | 1.8 | 1.0 | 0.601 | 0.267 |
| 49585 | 49520 | 66 | 59 | 88 | 96 | 3.5 | 3.3 | 23.4 | 0.40 | 1.5 | 0.82 | 0.744 | 0.389 |
| 529 | 522 | 59 | 58 | 89 | 95 | 0.8 | 3.3 | 22.1 | 0.29 | 2.1 | 1.2 | 0.822 | 0.416 |
| 529 X | 522 | 65 | 58 | 89 | 95 | 3.5 | 3.3 | 22.1 | 0.29 | 2.1 | 1.2 | 0.819 | 0.416 |
| HM 807046 | HM 807011 | 70 | 63 | 91 | 100 | 3.5 | 0.8 | 29.7 | 0.49 | 1.2 | 0.68 | 0.992 | 0.508 |
| HM 807046 | HM 807010 | 70 | 63 | 89 | 100 | 3.5 | 3.3 | 29.7 | 0.49 | 1.2 | 0.68 | 0.993 | 0.502 |
| 59200 | 59429 | 68 | 61 | 93 | 101 | 3.5 | 3.3 | 25.4 | 0.40 | 1.5 | 0.82 | 0.943 | 0.594 |
| 55200 C | 55437 | 71 | 65 | 92 | 105 | 3.5 | 3.3 | 37.6 | 0.88 | 0.68 | 0.37 | 0.845 | 0.514 |
| 55200 | 55437 | 71 | 64 | 92 | 105 | 3.5 | 3.3 | 37.3 | 0.88 | 0.68 | 0.37 | 0.767 | 0.514 |
| 72200 C | 72487 | 77 | 67 | 102 | 116 | 3.5 | 3.3 | 38.0 | 0.74 | 0.81 | 0.45 | 1.33 | 0.79 |
| 72200 | 72487 | 74 | 66 | 102 | 116 | 3.5 | 3.3 | 37.0 | 0.74 | 0.81 | 0.45 | 1.22 | 0.79 |
| 65200 | 65500 | 75 | 69 | 107 | 119 | 3.5 | 3.3 | 35.0 | 0.49 | 1.2 | 0.68 | 1.86 | 1.03 |
| 6279 | 6220 | 71 | 65 | 108 | 117 | 3.5 | 3.3 | 30.7 | 0.30 | 2.0 | 1.1 | 2.08 | 1.22 |
| 28584 | 28521 | 65 | 58 | 83 | 87 | 3.5 | 0.8 | 20.0 | 0.38 | 1.6 | 0.87 | 0.435 | 0.247 |
| 377 | 372 | 62 | 58 | 86 | 90 | 2.3 | 2 | 21.4 | 0.34 | 1.8 | 0.97 | 0.392 | 0.435 |
| 55206 | 55437 | 72 | 64 | 92 | 105 | 3.5 | 3.3 | 37.3 | 0.88 | 0.68 | 0.37 | 0.737 | 0.514 |

**Notes** * The maximum bore diameter is listed and its tolerance is negative (See Table **7.4.1** on Page **A136**).

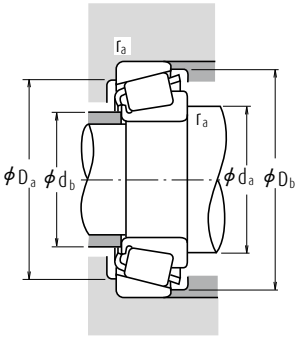
▲ The tolerances are listed in Tables **2, 3** and **4** on Pages **B202** and **B203**.

# Single-Row Tapered Roller Bearings (Inch Design)

## Bore Diameter 53.975 – 58.738 mm




| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Limiting Speeds ($min^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cone | Cup | | | | |
| d | D | T | B | C | r min. | | $C_r$ | $C_{0r}$ | Grease | Oil |
| **53.975** | 104.775 | 39.688 | 40.157 | 33.338 | 3.5 | 3.3 | 148 000 | 207 000 | 3 600 | 4 800 |
| | 107.950 | 36.512 | 36.957 | 28.575 | 3.5 | 3.3 | 144 000 | 182 000 | 3 600 | 4 800 |
| | 122.238 | 33.338 | 31.750 | 23.812 | 3.5 | 3.3 | 135 000 | 156 000 | 3 000 | 4 000 |
| | 123.825 | 36.512 | 32.791 | 25.400 | 3.5 | 3.3 | 143 000 | 160 000 | 3 000 | 4 000 |
| | 123.825 | 36.512 | 32.791 | 25.400 | 3.5 | 3.3 | 162 000 | 199 000 | 2 800 | 4 000 |
| | 123.825 | 38.100 | 36.678 | 30.162 | 3.5 | 3.3 | 161 000 | 221 000 | 3 000 | 4 000 |
| | 127.000 | 44.450 | 44.450 | 34.925 | 3.5 | 3.3 | 199 000 | 258 000 | 3 000 | 4 000 |
| | 127.000 | 50.800 | 52.388 | 41.275 | 3.5 | 3.3 | 236 000 | 300 000 | 3 200 | 4 300 |
| | 130.175 | 36.512 | 33.338 | 23.812 | 3.5 | 3.3 | 133 000 | 154 000 | 2 600 | 3 600 |
| **55.000** | 90.000 | 23.000 | 23.000 | 18.500 | 1.5 | 0.5 | 79 000 | 111 000 | 3 800 | 5 300 |
| | 95.000 | 29.000 | 29.000 | 23.500 | 1.5 | 2.5 | 111 000 | 152 000 | 3 800 | 5 000 |
| | 96.838 | 21.000 | 21.946 | 15.875 | 2.3 | 0.8 | 80 500 | 100 000 | 3 600 | 5 000 |
| | 110.000 | 39.000 | 39.000 | 32.000 | 3.0 | 2.5 | 177 000 | 225 000 | 3 400 | 4 500 |
| | 115.000 | 41.021 | 41.275 | 31.496 | 3.0 | 3.0 | 172 000 | 214 000 | 3 200 | 4 500 |
| **55.562** | 97.630 | 24.608 | 24.608 | 19.446 | 3.5 | 0.8 | 89 000 | 129 000 | 3 600 | 5 000 |
| | 122.238 | 43.658 | 43.764 | 36.512 | 1.3 | 3.3 | 198 000 | 292 000 | 3 000 | 4 000 |
| | 123.825 | 36.512 | 32.791 | 25.400 | 3.5 | 3.3 | 143 000 | 160 000 | 3 000 | 4 000 |
| | 123.825 | 36.512 | 32.791 | 25.400 | 3.5 | 3.3 | 162 000 | 199 000 | 2 800 | 4 000 |
| **57.150** | 96.838 | 21.000 | 21.946 | 15.875 | 3.5 | 0.8 | 80 500 | 100 000 | 3 600 | 5 000 |
| | 96.838 | 21.000 | 21.946 | 15.875 | 2.3 | 0.8 | 80 500 | 100 000 | 3 600 | 5 000 |
| | 96.838 | 25.400 | 21.946 | 20.275 | 3.5 | 2.3 | 80 500 | 100 000 | 3 600 | 5 000 |
| | 98.425 | 21.000 | 21.946 | 17.826 | 3.5 | 0.8 | 80 500 | 100 000 | 3 600 | 5 000 |
| | 104.775 | 30.162 | 29.317 | 24.605 | 3.5 | 3.3 | 116 000 | 149 000 | 3 400 | 4 800 |
| | 104.775 | 30.162 | 29.317 | 24.605 | 2.3 | 3.3 | 116 000 | 149 000 | 3 400 | 4 800 |
| | 104.775 | 30.162 | 30.958 | 23.812 | 0.8 | 3.3 | 130 000 | 170 000 | 3 400 | 4 800 |
| | 104.775 | 30.162 | 30.958 | 23.812 | 0.8 | 0.8 | 130 000 | 170 000 | 3 400 | 4 800 |
| | 122.238 | 33.338 | 31.750 | 23.812 | 3.5 | 3.3 | 135 000 | 156 000 | 3 000 | 4 000 |
| | 123.825 | 36.512 | 32.791 | 25.400 | 3.5 | 3.3 | 162 000 | 199 000 | 2 800 | 4 000 |
| | 123.825 | 38.100 | 36.678 | 30.162 | 3.5 | 3.3 | 161 000 | 221 000 | 3 000 | 4 000 |
| | 140.030 | 36.512 | 33.236 | 23.520 | 3.5 | 2.3 | 152 000 | 183 000 | 2 600 | 3 600 |
| | 144.983 | 36.000 | 33.236 | 23.007 | 3.5 | 3.5 | 152 000 | 183 000 | 2 600 | 3 600 |
| | 149.225 | 53.975 | 54.229 | 44.450 | 3.5 | 3.3 | 287 000 | 410 000 | 2 600 | 3 400 |
| **57.531** | 96.838 | 21.000 | 21.946 | 15.875 | 3.5 | 0.8 | 80 500 | 100 000 | 3 600 | 5 000 |
| **58.738** | 112.712 | 33.338 | 30.048 | 26.988 | 3.5 | 3.3 | 120 000 | 173 000 | 3 200 | 4 300 |




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | 0 | 0.4 | $Y_1$ |

## Static Equivalent Load

$P_0=0.5F_r+Y_0F_a$

When $F_r>0.5F_r+Y_0F_a$, use $P_0=F_r$

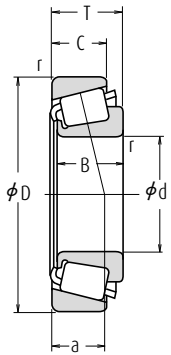
The values of e, $Y_1$ and $Y_0$ are given in the table below.

| Bearing Numbers | | Abutment and Fillet Dimensions (mm) | | | | | | Eff. Load Centers (mm) | Constant | Axial Load Factors | | Mass (kg) approx. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Cone | Cup | | | | | | |
| CONE | CUP | $d_a$ | $d_b$ | $D_a$ | $D_b$ | $r_a$ max. | | a | e | $Y_1$ | $Y_0$ | CONE | CUP |
| 4595 | 4535 | 70 | 63 | 90 | 99 | 3.5 | 3.3 | 27.4 | 0.34 | 1.79 | 0.98 | 0.989 | 0.589 |
| 539 | 532 X | 68 | 61 | 94 | 100 | 3.5 | 3.3 | 24.3 | 0.30 | 2.0 | 1.1 | 0.88 | 0.57 |
| 66584 | 66520 | 75 | 68 | 105 | 116 | 3.5 | 3.3 | 34.3 | 0.67 | 0.90 | 0.50 | 1.2 | 0.558 |
| 72212 | 72487 | 77 | 66 | 102 | 116 | 3.5 | 3.3 | 37.0 | 0.74 | 0.81 | 0.45 | 1.16 | 0.79 |
| 72212 C | 72487 | 79 | 67 | 102 | 116 | 3.5 | 3.3 | 38.0 | 0.74 | 0.81 | 0.45 | 1.27 | 0.79 |
| 557 S | 552 A | 71 | 65 | 109 | 116 | 3.5 | 3.3 | 28.8 | 0.35 | 1.7 | 0.95 | 1.49 | 0.764 |
| 65212 | 65500 | 77 | 71 | 107 | 119 | 3.5 | 3.3 | 35.0 | 0.49 | 1.2 | 0.68 | 1.76 | 1.03 |
| 6280 | 6220 | 74 | 67 | 108 | 117 | 3.5 | 3.3 | 30.7 | 0.30 | 2.0 | 1.1 | 1.97 | 1.22 |
| HM911242 | HM911210 | 79 | 74 | 109 | 124 | 3.5 | 3.3 | 42.2 | 0.82 | 0.73 | 0.40 | 1.45 | 0.725 |
| ▲ JLM506849 | ▲ JLM506810 | 63 | 61 | 82 | 86 | 1.5 | 0.5 | 19.7 | 0.40 | 1.5 | 0.82 | 0.378 | 0.186 |
| ▲ JM207049 | ▲ JM207010 | 64 | 62 | 85 | 91 | 1.5 | 2.5 | 21.3 | 0.33 | 1.8 | 0.99 | 0.59 | 0.26 |
| 385 | 382 A | 65 | 61 | 89 | 92 | 2.3 | 0.8 | 17.6 | 0.35 | 1.7 | 0.93 | 0.455 | 0.179 |
| ▲ JH307749 | ▲ JH307710 | 71 | 64 | 97 | 104 | 3 | 2.5 | 27.2 | 0.35 | 1.7 | 0.95 | 1.13 | 0.567 |
| 622 X | 614 X | 70 | 64 | 101 | 108 | 3 | 3 | 26.6 | 0.31 | 1.9 | 1.1 | 1.3 | 0.597 |
| 28680 | 28622 | 68 | 62 | 88 | 92 | 3.5 | 0.8 | 21.3 | 0.40 | 1.5 | 0.82 | 0.499 | 0.27 |
| 5566 | 5535 | 70 | 68 | 106 | 116 | 1.3 | 3.3 | 29.9 | 0.36 | 1.7 | 0.92 | 1.76 | 0.815 |
| 72218 | 72487 | 78 | 66 | 102 | 116 | 3.5 | 3.3 | 37.0 | 0.74 | 0.81 | 0.45 | 1.12 | 0.79 |
| 72218 C | 72487 | 80 | 67 | 102 | 116 | 3.5 | 3.3 | 38.0 | 0.74 | 0.81 | 0.45 | 1.23 | 0.79 |
| 387 A | 382 A | 69 | 62 | 89 | 92 | 3.5 | 0.8 | 17.6 | 0.35 | 1.7 | 0.93 | 0.42 | 0.179 |
| 387 | 382 A | 66 | 62 | 89 | 92 | 2.3 | 0.8 | 17.6 | 0.35 | 1.7 | 0.93 | 0.423 | 0.179 |
| 387 A | 382 S | 69 | 62 | 87 | 91 | 3.5 | 2.3 | 22.0 | 0.35 | 1.7 | 0.93 | 0.42 | 0.249 |
| 387 A | 382 | 69 | 62 | 90 | 92 | 3.5 | 0.8 | 17.6 | 0.35 | 1.7 | 0.93 | 0.42 | 0.226 |
| 469 | 453 X | 70 | 63 | 92 | 98 | 3.5 | 3.3 | 23.1 | 0.34 | 1.8 | 0.98 | 0.692 | 0.376 |
| 462 | 453 X | 67 | 63 | 92 | 98 | 2.3 | 3.3 | 23.1 | 0.34 | 1.8 | 0.98 | 0.694 | 0.376 |
| 45289 | 45220 | 65 | 65 | 93 | 99 | 0.8 | 3.3 | 21.9 | 0.33 | 1.8 | 0.99 | 0.752 | 0.347 |
| 45289 | 45221 | 65 | 65 | 95 | 99 | 0.8 | 0.8 | 21.9 | 0.33 | 1.8 | 0.99 | 0.76 | 0.35 |
| 66587 | 66520 | 77 | 71 | 105 | 116 | 3.5 | 3.3 | 34.3 | 0.67 | 0.90 | 0.50 | 1.14 | 0.558 |
| 72225 C | 72487 | 81 | 67 | 102 | 116 | 3.5 | 3.3 | 38.0 | 0.74 | 0.81 | 0.45 | 1.19 | 0.79 |
| 555 S | 552 A | 83 | 68 | 109 | 116 | 3.5 | 3.3 | 28.8 | 0.35 | 1.7 | 0.95 | 1.41 | 0.764 |
| 78225 | 78551 | 83 | 77 | 117 | 132 | 3.5 | 2.3 | 44.2 | 0.87 | 0.69 | 0.38 | 1.67 | 0.926 |
| 78225 | 78571 | 83 | 77 | 118 | 132 | 3.5 | 3.5 | 43.6 | 0.87 | 0.69 | 0.38 | 1.68 | 1.08 |
| 6455 | 6420 | 81 | 75 | 129 | 140 | 3.5 | 3.3 | 39.0 | 0.36 | 1.7 | 0.91 | 3.49 | 1.63 |
| 388 A | 382 A | 69 | 63 | 89 | 92 | 3.5 | 0.8 | 17.6 | 0.35 | 1.7 | 0.93 | 0.416 | 0.179 |
| 3981 | 3926 | 73 | 67 | 98 | 106 | 3.5 | 3.3 | 28.7 | 0.40 | 1.5 | 0.82 | 0.899 | 0.541 |

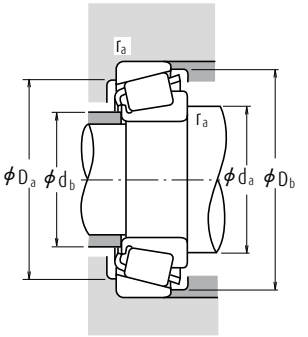
**Note** ▲ The tolerances are listed in Tables **2, 3** and **4** on Pages **B202** and **B203**.

# Single-Row Tapered Roller Bearings (Inch Design)

## Bore Diameter 60.000 – 64.963 mm




| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Limiting Speeds ($min^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cone | Cup | | | | |
| d | D | T | B | C | r min. | | $C_r$ | $C_{0r}$ | Grease | Oil |
| **60.000** | 95.000 | 24.000 | 24.000 | 19.000 | 5.0 | 2.5 | 86 500 | 125 000 | 3 600 | 5 000 |
| | 104.775 | 21.433 | 22.000 | 15.875 | 2.3 | 2.0 | 83 500 | 107 000 | 3 400 | 4 500 |
| | 110.000 | 22.000 | 21.996 | 18.824 | 0.8 | 1.3 | 85 500 | 113 000 | 3 200 | 4 300 |
| | 122.238 | 33.338 | 31.750 | 23.812 | 3.5 | 3.3 | 135 000 | 156 000 | 3 000 | 4 000 |
| **60.325** | 100.000 | 25.400 | 25.400 | 19.845 | 3.5 | 3.3 | 91 000 | 135 000 | 3 400 | 4 800 |
| | 101.600 | 25.400 | 25.400 | 19.845 | 3.5 | 3.3 | 91 000 | 135 000 | 3 400 | 4 800 |
| | 122.238 | 38.100 | 36.678 | 30.162 | 2.3 | 3.3 | 161 000 | 221 000 | 3 000 | 4 000 |
| | 122.238 | 38.100 | 38.354 | 29.718 | 8.0 | 1.5 | 188 000 | 245 000 | 3 000 | 4 000 |
| | 122.238 | 43.658 | 43.764 | 36.512 | 0.8 | 3.3 | 198 000 | 292 000 | 3 000 | 4 000 |
| | 127.000 | 44.450 | 44.450 | 34.925 | 3.5 | 3.3 | 199 000 | 258 000 | 3 000 | 4 000 |
| | 130.175 | 41.275 | 41.275 | 31.750 | 3.5 | 3.3 | 195 000 | 263 000 | 2 800 | 3 800 |
| | 135.755 | 53.975 | 56.007 | 44.450 | 3.5 | 3.3 | 264 000 | 355 000 | 2 800 | 3 800 |
| **61.912** | 136.525 | 46.038 | 46.038 | 36.512 | 3.5 | 3.3 | 233 000 | 370 000 | 2 600 | 3 400 |
| | 146.050 | 41.275 | 39.688 | 25.400 | 3.5 | 3.3 | 193 000 | 225 000 | 2 400 | 3 400 |
| | 152.400 | 47.625 | 46.038 | 31.750 | 3.5 | 3.3 | 237 000 | 267 000 | 2 400 | 3 400 |
| **63.500** | 94.458 | 19.050 | 19.050 | 15.083 | 1.5 | 1.5 | 59 000 | 100 000 | 3 600 | 4 800 |
| | 104.775 | 21.433 | 22.000 | 15.875 | 2.0 | 2.0 | 83 500 | 107 000 | 3 400 | 4 500 |
| | 107.950 | 25.400 | 25.400 | 19.050 | 1.5 | 3.3 | 90 000 | 138 000 | 3 200 | 4 300 |
| | 110.000 | 22.000 | 21.996 | 18.824 | 3.5 | 1.3 | 85 500 | 113 000 | 3 200 | 4 300 |
| | 110.000 | 22.000 | 21.996 | 18.824 | 1.5 | 1.3 | 85 500 | 113 000 | 3 200 | 4 300 |
| | 112.712 | 30.162 | 30.048 | 23.812 | 3.5 | 3.2 | 120 000 | 173 000 | 3 200 | 4 300 |
| | 112.712 | 30.162 | 30.162 | 23.812 | 3.5 | 3.3 | 142 000 | 202 000 | 3 200 | 4 300 |
| | 112.712 | 33.338 | 30.048 | 26.988 | 3.5 | 3.3 | 120 000 | 173 000 | 3 200 | 4 300 |
| | 122.238 | 38.100 | 38.354 | 29.718 | 7.0 | 3.3 | 188 000 | 245 000 | 3 000 | 4 000 |
| | 122.238 | 38.100 | 38.354 | 29.718 | 7.0 | 1.5 | 188 000 | 245 000 | 3 000 | 4 000 |
| | 122.238 | 38.100 | 38.354 | 29.718 | 3.5 | 1.5 | 188 000 | 245 000 | 3 000 | 4 000 |
| | 122.238 | 43.658 | 43.764 | 36.512 | 3.5 | 3.3 | 198 000 | 292 000 | 3 000 | 4 000 |
| | 123.825 | 38.100 | 36.678 | 30.162 | 3.5 | 3.3 | 161 000 | 221 000 | 3 000 | 4 000 |
| | 127.000 | 36.512 | 36.170 | 28.575 | 3.5 | 3.3 | 166 000 | 234 000 | 2 800 | 3 800 |
| | 130.175 | 41.275 | 41.275 | 31.750 | 3.5 | 3.3 | 195 000 | 263 000 | 2 800 | 3 800 |
| | 136.525 | 36.512 | 33.236 | 23.520 | 2.3 | 3.3 | 152 000 | 183 000 | 2 600 | 3 600 |
| | 136.525 | 41.275 | 41.275 | 31.750 | 3.5 | 3.3 | 195 000 | 263 000 | 2 800 | 3 800 |
| | 140.030 | 36.512 | 33.236 | 23.520 | 2.3 | 2.3 | 152 000 | 183 000 | 2 600 | 3 600 |
| **64.963** | 127.000 | 36.512 | 36.170 | 28.575 | 3.5 | 3.3 | 166 000 | 234 000 | 2 800 | 3 800 |




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | 0 | 0.4 | $Y_1$ |

## Static Equivalent Load

$P_0=0.5F_r+Y_0F_a$

When $F_r>0.5F_r+Y_0F_a$, use $P_0=F_r$

The values of e, $Y_1$ and $Y_0$ are given in the table below.

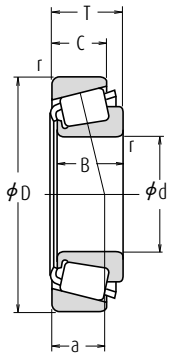
| Bearing Numbers | | Abutment and Fillet Dimensions (mm) | | | | | | Eff. Load Centers (mm) | Constant | Axial Load Factors | | Mass (kg) approx. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Cone | Cup | | | | | | |
| CONE | CUP | $d_a$ | $d_b$ | $D_a$ | $D_b$ | $r_a$ max. | | a | e | $Y_1$ | $Y_0$ | CONE | CUP |
| ▲ JLM 508748 | ▲ JLM 508710 | 75 | 66 | 85 | 91 | 5 | 2.5 | 21.6 | 0.40 | 1.5 | 0.82 | 0.43 | 0.20 |
| * 39236 | 39412 | 71 | 67 | 96 | 100 | 2.3 | 2 | 20.0 | 0.39 | 1.5 | 0.85 | 0.559 | 0.186 |
| 397 | 394 A | 69 | 68 | 101 | 104 | 0.8 | 1.3 | 20.9 | 0.40 | 1.5 | 0.82 | 0.642 | 0.263 |
| 66585 | 66520 | 79 | 73 | 105 | 116 | 3.5 | 3.3 | 34.3 | 0.67 | 0.90 | 0.50 | 1.07 | 0.558 |
| 28985 | 28921 | 73 | 67 | 89 | 96 | 3.5 | 3.3 | 22.9 | 0.43 | 1.4 | 0.78 | 0.538 | 0.232 |
| 28985 | 28920 | 73 | 67 | 90 | 97 | 3.5 | 3.3 | 22.9 | 0.43 | 1.4 | 0.78 | 0.538 | 0.272 |
| 558 | 553 X | 73 | 69 | 108 | 115 | 2.3 | 3.3 | 28.8 | 0.35 | 1.7 | 0.95 | 1.33 | 0.692 |
| HM 212044 | HM 212010 | 85 | 70 | 110 | 116 | 8 | 1.5 | 27.0 | 0.34 | 1.8 | 0.98 | 1.43 | 0.604 |
| 5582 | 5535 | 73 | 72 | 106 | 116 | 0.8 | 3.3 | 29.9 | 0.36 | 1.7 | 0.92 | 1.61 | 0.815 |
| 65237 | 65500 | 82 | 71 | 107 | 119 | 3.5 | 3.3 | 35.0 | 0.49 | 1.2 | 0.68 | 1.56 | 1.03 |
| 637 | 633 | 78 | 72 | 116 | 124 | 3.5 | 3.3 | 29.9 | 0.36 | 1.7 | 0.91 | 1.87 | 0.712 |
| 6376 | 6320 | 81 | 74 | 117 | 126 | 3.5 | 3.3 | 35.0 | 0.32 | 1.8 | 1.0 | 2.45 | 1.39 |
| H 715334 | H 715311 | 84 | 78 | 119 | 132 | 3.5 | 3.3 | 37.1 | 0.47 | 1.3 | 0.70 | 2.51 | 0.961 |
| H 913842 | H 913810 | 90 | 82 | 124 | 138 | 3.5 | 3.3 | 44.4 | 0.78 | 0.77 | 0.42 | 2.2 | 0.898 |
| 9180 | 9121 | 90 | 81 | 130 | 145 | 3.5 | 3.3 | 44.3 | 0.66 | 0.92 | 0.50 | 2.77 | 1.21 |
| L 610549 | L 610510 | 71 | 69 | 86 | 91 | 1.5 | 1.5 | 19.6 | 0.42 | 1.4 | 0.78 | 0.306 | 0.154 |
| 39250 | 39412 | 73 | 69 | 96 | 100 | 2 | 2 | 20.0 | 0.39 | 1.5 | 0.85 | 0.501 | 0.186 |
| 29586 | 29520 | 73 | 71 | 96 | 103 | 1.5 | 3.3 | 24.0 | 0.46 | 1.3 | 0.72 | 0.661 | 0.281 |
| 395 | 394 A | 77 | 70 | 101 | 104 | 3.5 | 1.3 | 20.9 | 0.40 | 1.5 | 0.82 | 0.58 | 0.263 |
| 390 A | 394 A | 73 | 70 | 101 | 104 | 1.5 | 1.3 | 20.9 | 0.40 | 1.5 | 0.82 | 0.583 | 0.263 |
| 3982 | 3920 | 77 | 71 | 99 | 106 | 3.5 | 3.2 | 25.5 | 0.40 | 1.5 | 0.82 | 0.789 | 0.454 |
| 39585 | 39520 | 77 | 71 | 101 | 107 | 3.5 | 3.3 | 23.5 | 0.34 | 1.8 | 0.97 | 0.899 | 0.359 |
| 3982 | 3926 | 78 | 71 | 98 | 106 | 3.5 | 3.3 | 28.7 | 0.40 | 1.5 | 0.82 | 0.789 | 0.541 |
| HM 212047 | HM 212011 | 87 | 73 | 108 | 116 | 7 | 3.3 | 26.9 | 0.34 | 1.8 | 0.98 | 1.34 | 0.598 |
| HM 212047 | HM 212010 | 87 | 73 | 110 | 116 | 7 | 1.5 | 26.9 | 0.34 | 1.8 | 0.98 | 1.34 | 0.604 |
| HM 212046 | HM 212010 | 80 | 73 | 110 | 116 | 3.5 | 1.5 | 26.9 | 0.34 | 1.8 | 0.98 | 1.35 | 0.604 |
| 5584 | 5535 | 81 | 75 | 106 | 116 | 3.5 | 3.3 | 29.9 | 0.36 | 1.7 | 0.92 | 1.5 | 0.815 |
| 559 | 522 A | 78 | 73 | 109 | 116 | 3.5 | 3.3 | 28.8 | 0.35 | 1.7 | 0.95 | 1.23 | 0.764 |
| 565 | 563 | 80 | 73 | 112 | 120 | 3.5 | 3.3 | 28.3 | 0.36 | 1.6 | 0.91 | 1.46 | 0.655 |
| 639 | 633 | 81 | 74 | 116 | 124 | 3.5 | 3.3 | 29.9 | 0.36 | 1.7 | 0.91 | 1.77 | 0.712 |
| 78250 | 78537 | 85 | 79 | 115 | 130 | 2.3 | 3.3 | 44.2 | 0.87 | 0.69 | 0.38 | 1.51 | 0.782 |
| 639 | 632 | 79 | 76 | 119 | 125 | 3.5 | 3.3 | 29.9 | 0.36 | 1.7 | 0.91 | 1.77 | 1.04 |
| 78250 | 78551 | 85 | 79 | 117 | 132 | 2.3 | 2.3 | 44.2 | 0.87 | 0.69 | 0.38 | 1.51 | 0.926 |
| 569 | 563 | 81 | 74 | 112 | 120 | 3.5 | 3.3 | 28.3 | 0.36 | 1.6 | 0.91 | 1.41 | 0.655 |

**Notes** * The maximum bore diameter is listed and its tolerance is negative (See Table **7.4.1** on Page **A136**).

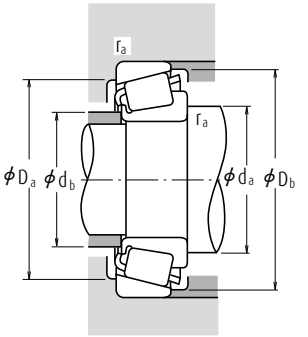
▲ The tolerances are listed in Tables **2, 3** and **4** on Pages **B202** and **B203**.

# Single-Row Tapered Roller Bearings (Inch Design)

## Bore Diameter 65.000 – 69.850 mm




| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Limiting Speeds (min$^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cone | Cup | | | | |
| d | D | T | B | C | r min. | | $C_r$ | $C_{0r}$ | Grease | Oil |
| **65.000** | 105.000 | 24.000 | 23.000 | 18.500 | 3.0 | 1.0 | 93 000 | 126 000 | 3 400 | 4 500 |
| | 110.000 | 28.000 | 28.000 | 22.500 | 3.0 | 2.5 | 120 000 | 173 000 | 3 200 | 4 300 |
| | 120.000 | 29.002 | 29.007 | 23.444 | 2.3 | 3.3 | 123 000 | 169 000 | 3 000 | 4 000 |
| | 120.000 | 39.000 | 38.500 | 32.000 | 3.0 | 2.5 | 185 000 | 249 000 | 3 000 | 4 000 |
| **65.088** | 135.755 | 53.975 | 56.007 | 44.450 | 3.5 | 3.3 | 264 000 | 355 000 | 2 800 | 3 800 |
| | 136.525 | 46.038 | 46.038 | 36.512 | 3.5 | 3.3 | 233 000 | 370 000 | 2 600 | 3 400 |
| **66.675** | 110.000 | 22.000 | 21.996 | 18.824 | 0.8 | 1.3 | 85 500 | 113 000 | 3 200 | 4 300 |
| | 110.000 | 22.000 | 21.996 | 18.824 | 3.5 | 1.3 | 85 500 | 113 000 | 3 200 | 4 300 |
| | 112.712 | 30.162 | 30.048 | 23.812 | 3.5 | 3.2 | 120 000 | 173 000 | 3 200 | 4 300 |
| | 112.712 | 30.162 | 30.048 | 23.812 | 5.5 | 3.2 | 120 000 | 173 000 | 3 200 | 4 300 |
| | 112.712 | 30.162 | 30.162 | 23.812 | 3.5 | 0.8 | 142 000 | 202 000 | 3 200 | 4 300 |
| | 112.712 | 30.162 | 30.162 | 23.812 | 3.5 | 3.3 | 142 000 | 202 000 | 3 200 | 4 300 |
| | 117.475 | 30.162 | 30.162 | 23.812 | 3.5 | 3.3 | 119 000 | 179 000 | 3 000 | 4 000 |
| | 122.238 | 38.100 | 36.678 | 30.162 | 3.5 | 3.3 | 161 000 | 221 000 | 3 000 | 4 000 |
| | 122.238 | 38.100 | 38.354 | 29.718 | 3.5 | 1.5 | 188 000 | 245 000 | 3 000 | 4 000 |
| | 122.238 | 38.100 | 38.354 | 29.718 | 3.5 | 3.3 | 188 000 | 245 000 | 3 000 | 4 000 |
| | 123.825 | 38.100 | 36.678 | 30.162 | 3.5 | 3.3 | 161 000 | 221 000 | 3 000 | 4 000 |
| | 136.525 | 46.038 | 46.038 | 36.512 | 3.5 | 3.3 | 233 000 | 370 000 | 2 600 | 3 400 |
| **68.262** | 110.000 | 22.000 | 21.996 | 18.824 | 2.3 | 1.3 | 85 500 | 113 000 | 3 200 | 4 300 |
| | 120.000 | 29.795 | 29.007 | 24.237 | 3.5 | 2.0 | 123 000 | 169 000 | 3 000 | 4 000 |
| | 122.238 | 38.100 | 36.678 | 30.162 | 3.5 | 3.3 | 161 000 | 221 000 | 3 000 | 4 000 |
| | 127.000 | 36.512 | 36.170 | 28.575 | 3.5 | 3.3 | 166 000 | 234 000 | 2 800 | 3 800 |
| | 136.525 | 41.275 | 41.275 | 31.750 | 3.5 | 3.3 | 229 000 | 297 000 | 2 600 | 3 600 |
| | 136.525 | 46.038 | 46.038 | 36.512 | 3.5 | 3.3 | 233 000 | 370 000 | 2 600 | 3 400 |
| | 152.400 | 47.625 | 46.038 | 31.750 | 3.5 | 3.3 | 237 000 | 267 000 | 2 400 | 3 400 |
| **69.850** | 112.712 | 22.225 | 21.996 | 15.875 | 1.5 | 0.8 | 85 000 | 113 000 | 3 000 | 4 000 |
| | 112.712 | 25.400 | 25.400 | 19.050 | 1.5 | 3.3 | 96 000 | 152 000 | 2 800 | 4 000 |
| | 117.475 | 30.162 | 30.162 | 23.812 | 3.5 | 3.3 | 119 000 | 179 000 | 3 000 | 4 000 |
| | 120.000 | 32.545 | 32.545 | 26.195 | 3.5 | 3.3 | 152 000 | 225 000 | 3 000 | 4 000 |
| | 120.650 | 25.400 | 25.400 | 19.050 | 1.5 | 3.3 | 96 000 | 152 000 | 2 800 | 4 000 |
| | 127.000 | 36.512 | 36.170 | 28.575 | 3.5 | 0.8 | 166 000 | 234 000 | 2 800 | 3 800 |
| | 130.175 | 41.275 | 41.275 | 31.750 | 3.5 | 3.3 | 195 000 | 263 000 | 2 800 | 3 800 |
| | 146.050 | 41.275 | 39.688 | 25.400 | 3.5 | 3.3 | 193 000 | 225 000 | 2 400 | 3 400 |
| | 146.050 | 41.275 | 41.275 | 31.750 | 3.5 | 3.3 | 207 000 | 296 000 | 2 400 | 3 200 |
| | 149.225 | 53.975 | 54.229 | 44.450 | 5.0 | 3.3 | 271 000 | 385 000 | 2 600 | 3 400 |
| | 150.089 | 44.450 | 46.672 | 36.512 | 3.5 | 3.3 | 265 000 | 370 000 | 2 400 | 3 200 |




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | 0 | 0.4 | $Y_1$ |

## Static Equivalent Load

$P_0=0.5F_r+Y_0F_a$

When $F_r>0.5F_r+Y_0F_a$, use $P_0=F_r$

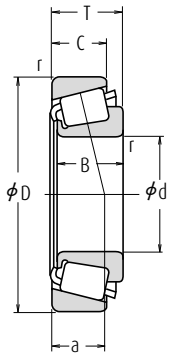
The values of e, $Y_1$ and $Y_0$ are given in the table below.

| Bearing Numbers | | Abutment and Fillet Dimensions (mm) | | | | | | Eff. Load Centers (mm) | Constant | Axial Load Factors | | Mass (kg) approx. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Cone | Cup | | | | | | |
| CONE | CUP | $d_a$ | $d_b$ | $D_a$ | $D_b$ | $r_a$ max. | | a | e | $Y_1$ | $Y_0$ | CONE | CUP |
| ▲ JLM 710949 | ▲ JLM 710910 | 77 | 71 | 96 | 101 | 3 | 1 | 23.7 | 0.45 | 1.3 | 0.73 | 0.526 | 0.237 |
| ▲ JM 511946 | ▲ JM 511910 | 78 | 72 | 99 | 105 | 3 | 2.5 | 24.5 | 0.40 | 1.5 | 0.82 | 0.72 | 0.342 |
| 478 | 472 A | 77 | 73 | 106 | 114 | 2.3 | 3.3 | 24.3 | 0.38 | 1.6 | 0.86 | 0.942 | 0.466 |
| ▲ JH 211749 | ▲ JH 211710 | 80 | 74 | 107 | 114 | 3 | 2.5 | 27.9 | 0.34 | 1.8 | 0.98 | 1.25 | 0.625 |
| 6379 | 6320 | 84 | 77 | 117 | 126 | 3.5 | 3.3 | 35.0 | 0.32 | 1.8 | 1.0 | 2.25 | 1.39 |
| H 715340 | H 715311 | 88 | 82 | 118 | 132 | 3.5 | 3.3 | 37.1 | 0.47 | 1.3 | 0.70 | 2.4 | 0.961 |
| 395 A | 394 A | 73 | 73 | 101 | 104 | 0.8 | 1.3 | 20.9 | 0.40 | 1.5 | 0.82 | 0.528 | 0.263 |
| 395 S | 394 A | 79 | 73 | 101 | 104 | 3.5 | 1.3 | 20.9 | 0.40 | 1.5 | 0.82 | 0.524 | 0.263 |
| 3984 | 3920 | 80 | 74 | 99 | 106 | 3.5 | 3.2 | 25.5 | 0.40 | 1.5 | 0.82 | 0.712 | 0.454 |
| 3994 | 3920 | 84 | 74 | 99 | 106 | 5.5 | 3.2 | 25.5 | 0.40 | 1.5 | 0.82 | 0.706 | 0.454 |
| 39590 | 39521 | 80 | 74 | 103 | 107 | 3.5 | 0.8 | 23.5 | 0.34 | 1.8 | 0.97 | 0.822 | 0.365 |
| 39590 | 39520 | 80 | 74 | 101 | 107 | 3.5 | 3.3 | 23.5 | 0.34 | 1.8 | 0.97 | 0.822 | 0.359 |
| 33262 | 33462 | 81 | 75 | 104 | 112 | 3.5 | 3.3 | 26.8 | 0.44 | 1.4 | 0.76 | 0.911 | 0.442 |
| 560 | 553 X | 81 | 75 | 108 | 115 | 3.5 | 3.3 | 28.8 | 0.35 | 1.7 | 0.95 | 1.14 | 0.692 |
| HM 212049 | HM 212010 | 82 | 75 | 110 | 116 | 3.5 | 1.5 | 26.9 | 0.34 | 1.8 | 0.98 | 1.25 | 0.604 |
| HM 212049 | HM 212011 | 81 | 74 | 108 | 116 | 3.5 | 3.3 | 26.9 | 0.34 | 1.8 | 0.98 | 1.25 | 0.598 |
| 560 | 552 A | 81 | 75 | 109 | 116 | 3.5 | 3.3 | 28.8 | 0.35 | 1.7 | 0.95 | 1.14 | 0.764 |
| H 715341 | H 715311 | 89 | 83 | 118 | 132 | 3.5 | 3.3 | 37.1 | 0.47 | 1.3 | 0.70 | 2.34 | 0.961 |
| 399 A | 394 A | 78 | 74 | 101 | 104 | 2.3 | 1.3 | 20.9 | 0.40 | 1.5 | 0.82 | 0.497 | 0.263 |
| 480 | 472 | 83 | 76 | 106 | 113 | 3.5 | 2 | 25.1 | 0.38 | 1.6 | 0.86 | 0.862 | 0.493 |
| 560 S | 553 X | 83 | 76 | 108 | 115 | 3.5 | 3.3 | 28.8 | 0.35 | 1.7 | 0.95 | 1.09 | 0.692 |
| 570 | 563 | 83 | 77 | 112 | 120 | 3.5 | 3.3 | 28.3 | 0.36 | 1.6 | 0.91 | 1.32 | 0.655 |
| H 414245 | H 414210 | 86 | 82 | 121 | 129 | 3.5 | 3.3 | 30.6 | 0.36 | 1.7 | 0.92 | 1.95 | 0.796 |
| H 715343 | H 715311 | 90 | 84 | 118 | 132 | 3.5 | 3.3 | 37.1 | 0.47 | 1.3 | 0.70 | 2.28 | 0.961 |
| 9185 | 9121 | 94 | 81 | 130 | 145 | 3.5 | 3.3 | 44.3 | 0.66 | 0.92 | 0.50 | 2.53 | 1.21 |
| LM 613449 | LM 613410 | 78 | 76 | 104 | 107 | 1.5 | 0.8 | 22.1 | 0.42 | 1.4 | 0.79 | 0.562 | 0.238 |
| 29675 | 29620 | 80 | 77 | 101 | 109 | 1.5 | 3.3 | 26.3 | 0.49 | 1.2 | 0.68 | 0.695 | 0.273 |
| 33275 | 33462 | 84 | 77 | 104 | 112 | 3.5 | 3.3 | 26.8 | 0.44 | 1.4 | 0.76 | 0.83 | 0.442 |
| 47487 | 47420 | 84 | 78 | 107 | 114 | 3.5 | 3.3 | 26.0 | 0.36 | 1.7 | 0.92 | 1.02 | 0.477 |
| 29675 | 29630 | 79 | 78 | 105 | 113 | 1.5 | 3.3 | 26.3 | 0.49 | 1.2 | 0.68 | 0.695 | 0.489 |
| 566 | 563 X | 85 | 78 | 114 | 120 | 3.5 | 0.8 | 28.3 | 0.36 | 1.6 | 0.91 | 1.27 | 0.658 |
| 643 | 633 | 86 | 80 | 116 | 124 | 3.5 | 3.3 | 29.9 | 0.36 | 1.7 | 0.91 | 1.56 | 0.712 |
| H 913849 | H 913810 | 95 | 82 | 124 | 138 | 3.5 | 3.3 | 44.4 | 0.78 | 0.77 | 0.42 | 1.95 | 0.898 |
| 655 | 653 | 88 | 82 | 131 | 139 | 3.5 | 3.3 | 33.2 | 0.41 | 1.5 | 0.81 | 2.35 | 0.891 |
| 6454 | 6420 | 94 | 85 | 129 | 140 | 5 | 3.3 | 39.0 | 0.36 | 1.7 | 0.91 | 2.80 | 1.67 |
| 745 A | 742 | 88 | 82 | 134 | 142 | 3.5 | 3.3 | 32.5 | 0.33 | 1.8 | 1.0 | 2.82 | 1.07 |

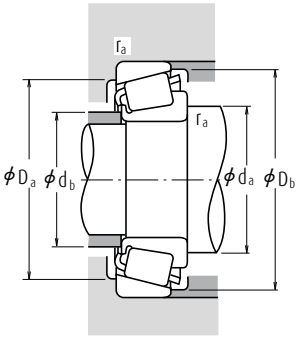
Note ▲ The tolerances are listed in Tables **2, 3** and **4** on Pages **B202** and **B203**.

# Single-Row Tapered Roller Bearings (Inch Design)

## Bore Diameter 70.000 – 76.200 mm




| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Limiting Speeds ($min^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cone | Cup | | | | |
| d | D | T | B | C | r min. | | $C_r$ | $C_{0r}$ | Grease | Oil |
| **70.000** | 110.000 | 26.000 | 25.000 | 20.500 | 1.0 | 2.5 | 98 500 | 152 000 | 3 000 | 4 000 |
| | 115.000 | 29.000 | 29.000 | 23.000 | 3.0 | 2.5 | 126 000 | 177 000 | 3 000 | 4 000 |
| | 120.000 | 29.795 | 29.007 | 24.237 | 2.0 | 2.0 | 123 000 | 169 000 | 3 000 | 4 000 |
| **71.438** | 117.475 | 30.162 | 30.162 | 23.812 | 3.5 | 3.3 | 119 000 | 179 000 | 3 000 | 4 000 |
| | 120.000 | 32.545 | 32.545 | 26.195 | 3.5 | 3.3 | 152 000 | 225 000 | 3 000 | 4 000 |
| | 127.000 | 36.512 | 36.170 | 28.575 | 6.4 | 3.3 | 166 000 | 234 000 | 2 800 | 3 800 |
| | 127.000 | 36.512 | 36.170 | 28.575 | 3.5 | 3.3 | 166 000 | 234 000 | 2 800 | 3 800 |
| | 130.175 | 41.275 | 41.275 | 31.750 | 6.4 | 3.3 | 195 000 | 263 000 | 2 800 | 3 800 |
| | 136.525 | 41.275 | 41.275 | 31.750 | 3.5 | 3.3 | 195 000 | 263 000 | 2 800 | 3 800 |
| | 136.525 | 41.275 | 41.275 | 31.750 | 3.5 | 3.3 | 229 000 | 297 000 | 2 600 | 3 600 |
| | 136.525 | 46.038 | 46.038 | 36.512 | 3.5 | 3.3 | 233 000 | 370 000 | 2 600 | 3 400 |
| **73.025** | 112.712 | 25.400 | 25.400 | 19.050 | 3.5 | 3.3 | 96 000 | 152 000 | 2 800 | 4 000 |
| | 117.475 | 30.162 | 30.162 | 23.812 | 3.5 | 3.3 | 119 000 | 179 000 | 3 000 | 4 000 |
| | 127.000 | 36.512 | 36.170 | 28.575 | 3.5 | 3.3 | 166 000 | 234 000 | 2 800 | 3 800 |
| | 146.050 | 41.275 | 41.275 | 31.750 | 3.5 | 3.3 | 207 000 | 296 000 | 2 400 | 3 200 |
| | 149.225 | 53.975 | 54.229 | 44.450 | 3.5 | 3.3 | 287 000 | 410 000 | 2 600 | 3 400 |
| **73.817** | 127.000 | 36.512 | 36.170 | 28.575 | 0.8 | 3.3 | 166 000 | 234 000 | 2 800 | 3 800 |
| **74.612** | 150.000 | 41.275 | 41.275 | 31.750 | 3.5 | 3.0 | 207 000 | 296 000 | 2 400 | 3 200 |
| **75.000** | 115.000 | 25.000 | 25.000 | 19.000 | 3.0 | 2.5 | 101 000 | 150 000 | 3 000 | 4 000 |
| | 120.000 | 31.000 | 29.500 | 25.000 | 3.0 | 2.5 | 129 000 | 198 000 | 2 800 | 3 800 |
| | 145.000 | 51.000 | 51.000 | 42.000 | 3.0 | 2.5 | 283 000 | 410 000 | 2 600 | 3 400 |
| **76.200** | 121.442 | 24.608 | 23.012 | 17.462 | 2.0 | 2.0 | 89 000 | 124 000 | 2 800 | 3 800 |
| | 127.000 | 30.162 | 31.000 | 22.225 | 3.5 | 3.3 | 134 000 | 195 000 | 2 800 | 3 800 |
| | 127.000 | 30.162 | 31.001 | 22.225 | 6.4 | 3.3 | 134 000 | 195 000 | 2 800 | 3 800 |
| | 133.350 | 33.338 | 33.338 | 26.195 | 0.8 | 3.3 | 154 000 | 237 000 | 2 600 | 3 600 |
| | 135.733 | 44.450 | 46.101 | 34.925 | 3.5 | 3.3 | 216 000 | 340 000 | 2 600 | 3 600 |
| | 136.525 | 30.162 | 29.769 | 22.225 | 3.5 | 3.3 | 130 000 | 192 000 | 2 600 | 3 400 |
| | 136.525 | 30.162 | 29.769 | 22.225 | 6.4 | 3.3 | 130 000 | 192 000 | 2 600 | 3 400 |
| | 139.992 | 36.512 | 36.098 | 28.575 | 3.5 | 3.3 | 175 000 | 260 000 | 2 600 | 3 400 |
| | 149.225 | 53.975 | 54.229 | 44.450 | 3.5 | 3.3 | 287 000 | 410 000 | 2 600 | 3 400 |
| | 152.400 | 39.688 | 36.322 | 30.162 | 3.5 | 3.2 | 183 000 | 285 000 | 2 200 | 3 200 |
| | 152.400 | 41.275 | 41.275 | 31.750 | 3.5 | 3.3 | 207 000 | 296 000 | 2 400 | 3 200 |
| | 161.925 | 49.212 | 46.038 | 31.750 | 3.5 | 3.3 | 248 000 | 290 000 | 2 200 | 3 000 |
| | 161.925 | 53.975 | 55.100 | 42.862 | 3.5 | 3.3 | 325 000 | 480 000 | 2 200 | 3 000 |
| | 161.925 | 53.975 | 55.100 | 42.862 | 6.4 | 3.3 | 325 000 | 480 000 | 2 200 | 3 000 |
| | 161.925 | 53.975 | 55.100 | 42.862 | 6.4 | 0.8 | 325 000 | 480 000 | 2 200 | 3 000 |




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | 0 | 0.4 | $Y_1$ |

## Static Equivalent Load

$P_0=0.5F_r+Y_0F_a$

When $F_r>0.5F_r+Y_0F_a$, use $P_0=F_r$

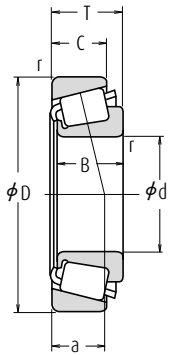
The values of e, $Y_1$ and $Y_0$ are given in the table below.

| Bearing Numbers | | Abutment and Fillet Dimensions (mm) | | | | | | Eff. Load Centers (mm) | Constant | Axial Load Factors | | Mass (kg) approx. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Cone | Cup | | | | | | |
| CONE | CUP | $d_a$ | $d_b$ | $D_a$ | $D_b$ | $r_a$ max. | | a | e | $Y_1$ | $Y_0$ | CONE | CUP |
| ▲ JLM 813049 | ▲ JLM 813010 | 78 | 77 | 98 | 105 | 1 | 2.5 | 26.2 | 0.49 | 1.2 | 0.68 | 0.604 | 0.304 |
| ▲ JM 612949 | ▲ JM 612910 | 83 | 77 | 103 | 110 | 3 | 2.5 | 26.4 | 0.43 | 1.4 | 0.77 | 0.800 | 0.362 |
| 484 | 472 | 80 | 78 | 106 | 113 | 2 | 2 | 25.1 | 0.38 | 1.6 | 0.86 | 0.822 | 0.493 |
| 33281 | 33462 | 85 | 79 | 104 | 112 | 3.5 | 3.3 | 26.8 | 0.44 | 1.4 | 0.76 | 0.789 | 0.442 |
| 47490 | 47420 | 86 | 79 | 107 | 114 | 3.5 | 3.3 | 26.0 | 0.36 | 1.7 | 0.92 | 0.983 | 0.477 |
| 567 S | 563 | 92 | 80 | 112 | 120 | 6.4 | 3.3 | 28.3 | 0.36 | 1.6 | 0.91 | 1.21 | 0.655 |
| 567 A | 563 | 86 | 80 | 112 | 120 | 3.5 | 3.3 | 28.3 | 0.36 | 1.6 | 0.91 | 1.23 | 0.655 |
| 645 | 633 | 93 | 81 | 116 | 124 | 6.4 | 3.3 | 29.9 | 0.36 | 1.7 | 0.91 | 1.49 | 0.712 |
| 644 | 632 | 87 | 81 | 118 | 125 | 3.5 | 3.3 | 29.9 | 0.36 | 1.7 | 0.91 | 1.5 | 1.04 |
| H 414249 | H 414210 | 89 | 83 | 121 | 129 | 3.5 | 3.3 | 30.6 | 0.36 | 1.7 | 0.92 | 1.83 | 0.796 |
| H 715345 | H 715311 | 92 | 84 | 119 | 132 | 3.5 | 3.3 | 37.1 | 0.47 | 1.3 | 0.70 | 2.15 | 0.961 |
| 29685 | 29620 | 86 | 80 | 101 | 109 | 3.5 | 3.3 | 26.3 | 0.49 | 1.2 | 0.68 | 0.62 | 0.273 |
| 33287 | 33462 | 87 | 80 | 104 | 112 | 3.5 | 3.3 | 26.8 | 0.44 | 1.4 | 0.76 | 0.746 | 0.442 |
| 567 | 563 | 88 | 81 | 112 | 120 | 3.5 | 3.3 | 28.3 | 0.36 | 1.6 | 0.91 | 1.17 | 0.655 |
| 657 | 653 | 91 | 85 | 131 | 139 | 3.5 | 3.3 | 33.2 | 0.41 | 1.5 | 0.81 | 2.24 | 0.891 |
| 6460 | 6420 | 93 | 87 | 129 | 140 | 3.5 | 3.3 | 39.0 | 0.36 | 1.7 | 0.91 | 2.8 | 1.63 |
| 568 | 563 | 83 | 82 | 112 | 120 | 0.8 | 3.3 | 28.3 | 0.36 | 1.6 | 0.91 | 1.15 | 0.655 |
| 658 | 653 X | 92 | 86 | 133 | 141 | 3.5 | 3 | 33.2 | 0.41 | 1.5 | 0.81 | 2.37 | 0.932 |
| ▲ JLM 714149 | ▲ JLM 714110 | 87 | 81 | 104 | 110 | 3 | 2.5 | 25.3 | 0.46 | 1.3 | 0.72 | 0.638 | 0.272 |
| ▲ JM 714249 | ▲ JM 714210 | 88 | 83 | 108 | 115 | 3 | 2.5 | 28.8 | 0.44 | 1.4 | 0.74 | 0.863 | 0.436 |
| ▲ JH 415647 | ▲ JH 415610 | 94 | 89 | 129 | 139 | 3 | 2.5 | 36.7 | 0.36 | 1.7 | 0.91 | 2.64 | 1.19 |
| 34300 | 34478 | 86 | 84 | 111 | 116 | 2 | 2 | 26.3 | 0.45 | 1.3 | 0.73 | 0.65 | 0.316 |
| 42687 | 42620 | 90 | 84 | 114 | 121 | 3.5 | 3.3 | 27.3 | 0.42 | 1.4 | 0.79 | 1.03 | 0.438 |
| 42688 | 42620 | 94 | 84 | 114 | 121 | 6.4 | 3.3 | 27.3 | 0.42 | 1.4 | 0.79 | 1.01 | 0.438 |
| 47680 | 47620 | 86 | 85 | 119 | 128 | 0.8 | 3.3 | 29.0 | 0.40 | 1.5 | 0.82 | 1.39 | 0.577 |
| 5760 | 5735 | 94 | 88 | 119 | 130 | 3.5 | 3.3 | 32.9 | 0.41 | 1.5 | 0.81 | 1.86 | 0.887 |
| 495 A | 493 | 92 | 86 | 122 | 130 | 3.5 | 3.3 | 28.7 | 0.44 | 1.4 | 0.74 | 1.27 | 0.55 |
| 495 AX | 493 | 98 | 86 | 122 | 130 | 6.4 | 3.3 | 28.7 | 0.44 | 1.4 | 0.74 | 1.26 | 0.55 |
| 575 | 572 | 92 | 86 | 125 | 133 | 3.5 | 3.3 | 31.1 | 0.40 | 1.5 | 0.82 | 1.61 | 0.788 |
| 6461 | 6420 | 96 | 89 | 129 | 140 | 3.5 | 3.3 | 39.0 | 0.36 | 1.7 | 0.91 | 2.64 | 1.63 |
| 590 A | 592 A | 95 | 89 | 135 | 145 | 3.5 | 3.2 | 37.1 | 0.44 | 1.4 | 0.75 | 2.2 | 1.06 |
| 659 | 652 | 93 | 87 | 134 | 141 | 3.5 | 3.3 | 33.2 | 0.41 | 1.5 | 0.81 | 2.11 | 1.26 |
| 9285 | 9220 | 103 | 90 | 138 | 153 | 3.5 | 3.3 | 49.8 | 0.71 | 0.85 | 0.47 | 2.82 | 1.4 |
| 6576 | 6535 | 99 | 92 | 141 | 154 | 3.5 | 3.3 | 40.7 | 0.40 | 1.5 | 0.82 | 3.74 | 1.67 |
| 6575 | 6535 | 104 | 92 | 141 | 154 | 6.4 | 3.3 | 40.7 | 0.40 | 1.5 | 0.82 | 3.73 | 1.67 |
| 6575 | 6536 | 104 | 92 | 144 | 154 | 6.4 | 0.8 | 40.7 | 0.40 | 1.5 | 0.82 | 3.73 | 1.68 |

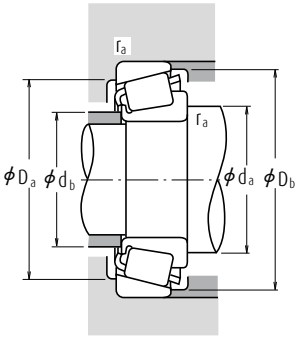
Note ▲ The tolerances are listed in Tables **2, 3** and **4** on Pages **B202** and **B203**.

# Single-Row Tapered Roller Bearings (Inch Design)

## Bore Diameter 76.200 – 83.345 mm




| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Limiting Speeds ($min^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cone | Cup | | | | |
| d | D | T | B | C | r min. | | $C_r$ | $C_{0r}$ | Grease | Oil |
| **76.200** | 168.275 | 53.975 | 56.363 | 41.275 | 6.4 | 3.3 | 345 000 | 470 000 | 2 200 | 3 000 |
| | 168.275 | 53.975 | 56.363 | 41.275 | 0.8 | 3.3 | 345 000 | 470 000 | 2 200 | 3 000 |
| | 171.450 | 49.212 | 46.038 | 31.750 | 3.5 | 3.3 | 257 000 | 310 000 | 2 000 | 2 800 |
| | 177.800 | 55.562 | 50.800 | 34.925 | 3.5 | 3.3 | 257 000 | 310 000 | 2 000 | 2 800 |
| **77.788** | 121.442 | 24.608 | 23.012 | 17.462 | 3.5 | 2.0 | 89 000 | 124 000 | 2 800 | 3 800 |
| | 127.000 | 30.162 | 31.000 | 22.225 | 3.5 | 3.3 | 134 000 | 195 000 | 2 800 | 3 800 |
| | 135.733 | 44.450 | 46.101 | 34.925 | 3.5 | 3.3 | 216 000 | 340 000 | 2 600 | 3 600 |
| **79.375** | 146.050 | 41.275 | 41.275 | 31.750 | 3.5 | 3.3 | 207 000 | 296 000 | 2 400 | 3 200 |
| | 150.089 | 44.450 | 46.672 | 36.512 | 3.5 | 3.3 | 265 000 | 370 000 | 2 400 | 3 200 |
| **80.000** | 130.000 | 35.000 | 34.000 | 28.500 | 3.0 | 2.5 | 166 000 | 251 000 | 2 600 | 3 600 |
| **80.962** | 136.525 | 30.162 | 29.769 | 22.225 | 3.5 | 3.3 | 130 000 | 192 000 | 2 600 | 3 400 |
| | 139.700 | 36.512 | 36.098 | 28.575 | 3.5 | 3.3 | 175 000 | 260 000 | 2 600 | 3 400 |
| | 139.992 | 36.512 | 36.098 | 28.575 | 3.5 | 3.3 | 175 000 | 260 000 | 2 600 | 3 400 |
| **82.550** | 125.412 | 25.400 | 25.400 | 19.845 | 3.5 | 1.5 | 102 000 | 164 000 | 2 600 | 3 600 |
| | 133.350 | 30.162 | 29.769 | 22.225 | 3.5 | 3.3 | 130 000 | 192 000 | 2 600 | 3 400 |
| | 133.350 | 33.338 | 33.338 | 26.195 | 3.5 | 3.3 | 154 000 | 237 000 | 2 600 | 3 600 |
| | 133.350 | 33.338 | 33.338 | 26.195 | 0.8 | 3.3 | 154 000 | 237 000 | 2 600 | 3 600 |
| | 133.350 | 33.338 | 33.338 | 26.195 | 6.8 | 3.3 | 154 000 | 237 000 | 2 600 | 3 600 |
| | 133.350 | 39.688 | 39.688 | 32.545 | 6.8 | 3.3 | 179 000 | 310 000 | 2 600 | 3 600 |
| | 136.525 | 30.162 | 29.769 | 22.225 | 3.5 | 3.3 | 130 000 | 192 000 | 2 600 | 3 400 |
| | 139.700 | 36.512 | 36.098 | 28.575 | 3.5 | 3.3 | 175 000 | 260 000 | 2 600 | 3 400 |
| | 139.992 | 36.512 | 36.098 | 28.575 | 3.5 | 3.3 | 175 000 | 260 000 | 2 600 | 3 400 |
| | 139.992 | 36.512 | 36.098 | 28.575 | 6.8 | 3.3 | 175 000 | 260 000 | 2 600 | 3 400 |
| | 146.050 | 41.275 | 41.275 | 31.750 | 3.5 | 3.3 | 207 000 | 296 000 | 2 400 | 3 200 |
| | 150.000 | 44.455 | 46.672 | 35.000 | 3.5 | 3.3 | 265 000 | 370 000 | 2 400 | 3 200 |
| | 150.089 | 44.450 | 46.672 | 36.512 | 3.5 | 3.3 | 265 000 | 370 000 | 2 400 | 3 200 |
| | 152.400 | 41.275 | 41.275 | 31.750 | 3.5 | 3.3 | 207 000 | 296 000 | 2 400 | 3 200 |
| | 161.925 | 47.625 | 48.260 | 38.100 | 3.5 | 3.3 | 274 000 | 390 000 | 2 200 | 3 000 |
| | 161.925 | 53.975 | 55.100 | 42.862 | 3.5 | 3.3 | 325 000 | 480 000 | 2 200 | 3 000 |
| | 168.275 | 47.625 | 48.260 | 38.100 | 3.5 | 3.3 | 274 000 | 390 000 | 2 200 | 3 000 |
| | 168.275 | 53.975 | 56.363 | 41.275 | 3.5 | 3.3 | 345 000 | 470 000 | 2 200 | 3 000 |
| **83.345** | 125.412 | 25.400 | 25.400 | 19.845 | 3.5 | 1.5 | 102 000 | 164 000 | 2 600 | 3 600 |
| | 125.412 | 25.400 | 25.400 | 19.845 | 0.8 | 1.5 | 102 000 | 164 000 | 2 600 | 3 600 |




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | 0 | 0.4 | $Y_1$ |

## Static Equivalent Load

$P_0=0.5F_r+Y_0F_a$

When $F_r>0.5F_r+Y_0F_a$, use $P_0=F_r$

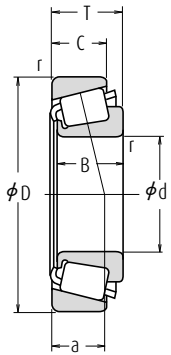
The values of e, $Y_1$ and $Y_0$ are given in the table below.

| Bearing Numbers | | Abutment and Fillet Dimensions (mm) | | | | | | Eff. Load Centers (mm) | Constant | Axial Load Factors | | Mass (kg) approx. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Cone | Cup | | | | | | |
| CONE | CUP | $d_a$ | $d_b$ | $D_a$ | $D_b$ | $r_a$ max. | | a | e | $Y_1$ | $Y_0$ | CONE | CUP |
| **843** | **832** | 101 | 89 | 149 | 155 | 6.4 | 3.3 | 35.2 | 0.30 | 2.0 | 1.1 | 4.11 | 1.74 |
| **837** | **832** | 90 | 89 | 149 | 155 | 0.8 | 3.3 | 35.2 | 0.30 | 2.0 | 1.1 | 4.13 | 1.74 |
| **9380** | **9321** | 105 | 98 | 147 | 164 | 3.5 | 3.3 | 54.1 | 0.76 | 0.79 | 0.43 | 3.47 | 1.51 |
| **9378** | **9320** | 105 | 98 | 148 | 164 | 3.5 | 3.3 | 57.3 | 0.76 | 0.79 | 0.43 | 3.71 | 2.24 |
| **34306** | **34478** | 90 | 84 | 110 | 116 | 3.5 | 2 | 26.3 | 0.45 | 1.3 | 0.73 | 0.612 | 0.316 |
| **42690** | **42620** | 91 | 85 | 114 | 121 | 3.5 | 3.3 | 27.3 | 0.42 | 1.4 | 0.79 | 0.976 | 0.438 |
| **5795** | **5735** | 96 | 89 | 119 | 130 | 3.5 | 3.3 | 32.9 | 0.41 | 1.5 | 0.81 | 1.79 | 0.887 |
| **661** | **653** | 96 | 90 | 131 | 139 | 3.5 | 3.3 | 33.2 | 0.41 | 1.5 | 0.81 | 1.99 | 0.891 |
| **750** | **742** | 96 | 90 | 134 | 142 | 3.5 | 3.3 | 32.5 | 0.33 | 1.8 | 1.0 | 2.42 | 1.07 |
| ▲ **JM 515649** | ▲ **JM 515610** | 94 | 88 | 117 | 125 | 3 | 2.5 | 29.9 | 0.39 | 1.5 | 0.85 | 1.18 | 0.583 |
| **496** | **493** | 95 | 89 | 122 | 130 | 3.5 | 3.3 | 28.7 | 0.44 | 1.4 | 0.74 | 1.13 | 0.55 |
| **581** | **572 X** | 96 | 90 | 125 | 133 | 3.5 | 3.3 | 31.1 | 0.40 | 1.5 | 0.82 | 1.44 | 0.774 |
| **581** | **572** | 96 | 90 | 125 | 133 | 3.5 | 3.3 | 31.1 | 0.40 | 1.5 | 0.82 | 1.44 | 0.788 |
| **27687** | **27620** | 96 | 89 | 115 | 120 | 3.5 | 1.5 | 25.7 | 0.42 | 1.4 | 0.79 | 0.747 | 0.348 |
| **495** | **492 A** | 97 | 90 | 120 | 128 | 3.5 | 3.3 | 28.7 | 0.44 | 1.4 | 0.74 | 1.08 | 0.434 |
| **47686** | **47620** | 97 | 90 | 119 | 128 | 3.5 | 3.3 | 29.0 | 0.40 | 1.5 | 0.82 | 1.18 | 0.577 |
| **47685** | **47620** | 90 | 90 | 119 | 128 | 0.8 | 3.3 | 29.0 | 0.40 | 1.5 | 0.82 | 1.18 | 0.577 |
| **47687** | **47620** | 103 | 90 | 119 | 128 | 6.8 | 3.3 | 29.0 | 0.40 | 1.5 | 0.82 | 1.16 | 0.577 |
| **HM 516448** | **HM 516410** | 105 | 92 | 118 | 128 | 6.8 | 3.3 | 32.4 | 0.40 | 1.5 | 0.82 | 1.35 | 0.767 |
| **495** | **493** | 97 | 90 | 122 | 130 | 3.5 | 3.3 | 28.7 | 0.44 | 1.4 | 0.74 | 1.08 | 0.55 |
| **580** | **572 X** | 98 | 91 | 125 | 133 | 3.5 | 3.3 | 31.1 | 0.40 | 1.5 | 0.82 | 1.39 | 0.774 |
| **580** | **572** | 98 | 91 | 125 | 133 | 3.5 | 3.3 | 31.1 | 0.40 | 1.5 | 0.82 | 1.39 | 0.788 |
| **582** | **572** | 104 | 91 | 125 | 133 | 6.8 | 3.3 | 31.1 | 0.40 | 1.5 | 0.82 | 1.37 | 0.788 |
| **663** | **653** | 99 | 92 | 131 | 139 | 3.5 | 3.3 | 33.2 | 0.41 | 1.5 | 0.81 | 1.85 | 0.891 |
| **749 A** | **743** | 99 | 93 | 134 | 142 | 3.5 | 3.3 | 32.5 | 0.33 | 1.8 | 1.0 | 2.26 | 1.04 |
| **749 A** | **742** | 98 | 93 | 135 | 143 | 3.5 | 3.3 | 32.5 | 0.33 | 1.8 | 1.0 | 2.26 | 1.07 |
| **663** | **652** | 99 | 92 | 134 | 141 | 3.5 | 3.3 | 33.2 | 0.41 | 1.5 | 0.81 | 1.85 | 1.26 |
| **757** | **752** | 100 | 94 | 144 | 150 | 3.5 | 3.3 | 35.6 | 0.34 | 1.8 | 0.97 | 2.79 | 1.61 |
| **6559** | **6535** | 104 | 98 | 141 | 154 | 3.5 | 3.3 | 40.7 | 0.40 | 1.5 | 0.82 | 3.4 | 1.67 |
| **757** | **753** | 100 | 94 | 147 | 150 | 3.5 | 3.3 | 35.6 | 0.34 | 1.8 | 0.97 | 2.79 | 2.1 |
| **842** | **832** | 101 | 94 | 149 | 155 | 3.5 | 3.3 | 35.2 | 0.30 | 2.0 | 1.1 | 3.76 | 1.74 |
| **27690** | **27620** | 96 | 90 | 115 | 120 | 3.5 | 1.5 | 25.7 | 0.42 | 1.4 | 0.79 | 0.727 | 0.348 |
| **27689** | **27620** | 90 | 90 | 115 | 120 | 0.8 | 1.5 | 25.7 | 0.42 | 1.4 | 0.79 | 0.732 | 0.348 |

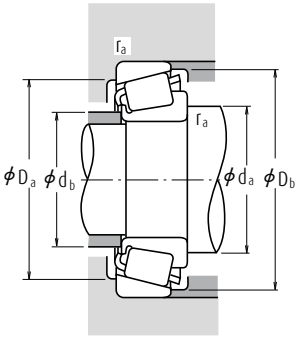
**Note** ▲ The tolerances are listed in Tables **2, 3** and **4** on Pages **B202** and **B203**.

# Single-Row Tapered Roller Bearings (Inch Design)

## Bore Diameter 84.138 – 90.488 mm




| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Limiting Speeds (min$^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cone | Cup | | | | |
| d | D | T | B | C | r min. | | $C_r$ | $C_{0r}$ | Grease | Oil |
| **84.138** | 136.525 | 30.162 | 29.769 | 22.225 | 3.5 | 3.3 | 130 000 | 192 000 | 2 600 | 3 400 |
| | 146.050 | 41.275 | 41.275 | 31.750 | 3.5 | 3.3 | 207 000 | 296 000 | 2 400 | 3 200 |
| | 171.450 | 49.212 | 46.038 | 31.750 | 3.5 | 3.3 | 257 000 | 310 000 | 2 000 | 2 800 |
| **85.000** | 130.000 | 30.000 | 29.000 | 24.000 | 6.0 | 2.5 | 138 000 | 222 000 | 2 600 | 3 600 |
| | 130.000 | 30.000 | 29.000 | 24.000 | 3.0 | 2.5 | 138 000 | 222 000 | 2 600 | 3 600 |
| | 140.000 | 39.000 | 38.000 | 31.500 | 3.0 | 2.5 | 202 000 | 305 000 | 2 400 | 3 400 |
| | 150.000 | 46.000 | 46.000 | 38.000 | 3.0 | 2.5 | 275 000 | 390 000 | 2 400 | 3 200 |
| **85.026** | 150.089 | 44.450 | 46.672 | 36.512 | 3.5 | 3.3 | 265 000 | 370 000 | 2 400 | 3 200 |
| | 150.089 | 44.450 | 46.672 | 36.512 | 5.0 | 3.3 | 265 000 | 370 000 | 2 400 | 3 200 |
| **85.725** | 133.350 | 30.162 | 29.769 | 22.225 | 3.5 | 3.3 | 130 000 | 192 000 | 2 600 | 3 400 |
| | 136.525 | 30.162 | 29.769 | 22.225 | 3.5 | 3.3 | 130 000 | 192 000 | 2 600 | 3 400 |
| | 142.138 | 42.862 | 42.862 | 34.133 | 4.8 | 3.3 | 221 000 | 360 000 | 2 400 | 3 400 |
| | 146.050 | 41.275 | 41.275 | 31.750 | 6.4 | 3.3 | 207 000 | 296 000 | 2 400 | 3 200 |
| | 146.050 | 41.275 | 41.275 | 31.750 | 3.5 | 3.3 | 207 000 | 296 000 | 2 400 | 3 200 |
| | 152.400 | 39.688 | 36.322 | 30.162 | 3.5 | 3.2 | 183 000 | 285 000 | 2 200 | 3 200 |
| | 161.925 | 47.625 | 48.260 | 38.100 | 3.5 | 3.3 | 274 000 | 390 000 | 2 200 | 3 000 |
| | 168.275 | 41.275 | 41.275 | 30.162 | 3.5 | 3.3 | 223 000 | 345 000 | 2 000 | 2 800 |
| **87.312** | 190.500 | 57.150 | 57.531 | 46.038 | 8.0 | 3.3 | 390 000 | 520 000 | 1 900 | 2 600 |
| **88.900** | 149.225 | 31.750 | 28.971 | 24.608 | 3.0 | 3.3 | 140 000 | 218 000 | 2 200 | 3 000 |
| | 152.400 | 39.688 | 36.322 | 30.162 | 3.5 | 3.2 | 183 000 | 285 000 | 2 200 | 3 200 |
| | 152.400 | 39.688 | 39.688 | 30.162 | 6.4 | 3.3 | 253 000 | 365 000 | 2 200 | 3 200 |
| | 161.925 | 47.625 | 48.260 | 38.100 | 3.5 | 3.3 | 274 000 | 390 000 | 2 200 | 3 000 |
| | 161.925 | 47.625 | 48.260 | 38.100 | 7.0 | 3.3 | 274 000 | 390 000 | 2 200 | 3 000 |
| | 161.925 | 53.975 | 55.100 | 42.862 | 3.5 | 3.3 | 325 000 | 480 000 | 2 200 | 3 000 |
| | 168.275 | 47.625 | 48.260 | 38.100 | 3.5 | 3.3 | 274 000 | 390 000 | 2 200 | 3 000 |
| | 168.275 | 53.975 | 56.363 | 41.275 | 3.5 | 3.3 | 345 000 | 470 000 | 2 200 | 3 000 |
| | 190.500 | 57.150 | 57.531 | 44.450 | 8.0 | 3.3 | 355 000 | 500 000 | 1 900 | 2 600 |
| | 190.500 | 57.150 | 57.531 | 46.038 | 8.0 | 3.3 | 390 000 | 520 000 | 1 900 | 2 600 |
| **90.000** | 145.000 | 35.000 | 34.000 | 27.000 | 3.0 | 2.5 | 190 000 | 285 000 | 2 400 | 3 200 |
| | 147.000 | 40.000 | 40.000 | 32.500 | 7.0 | 3.5 | 229 000 | 345 000 | 2 400 | 3 200 |
| | 155.000 | 44.000 | 44.000 | 35.500 | 3.0 | 2.5 | 274 000 | 390 000 | 2 200 | 3 000 |
| **90.488** | 161.925 | 47.625 | 48.260 | 38.100 | 3.5 | 3.3 | 274 000 | 390 000 | 2 200 | 3 000 |




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | 0 | 0.4 | $Y_1$ |

## Static Equivalent Load

$P_0=0.5F_r+Y_0F_a$

When $F_r>0.5F_r+Y_0F_a$, use $P_0=F_r$

The values of e, $Y_1$ and $Y_0$ are given in the table below.

| Bearing Numbers | | Abutment and Fillet Dimensions (mm) | | | | | | Eff. Load Centers (mm) | Constant | Axial Load Factors | | Mass (kg) approx. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Cone | Cup | | | | | | |
| CONE | CUP | $d_a$ | $d_b$ | $D_a$ | $D_b$ | $r_a$ max. | | a | e | $Y_1$ | $Y_0$ | CONE | CUP |
| 498 | 493 | 98 | 91 | 122 | 130 | 3.5 | 3.3 | 28.7 | 0.44 | 1.4 | 0.74 | 1.04 | 0.55 |
| 664 | 653 | 99 | 93 | 131 | 139 | 3.5 | 3.3 | 33.2 | 0.41 | 1.5 | 0.81 | 1.79 | 0.891 |
| 9385 | 9321 | 111 | 98 | 147 | 164 | 3.5 | 3.3 | 54.1 | 0.76 | 0.79 | 0.43 | 3.11 | 1.51 |
| ▲ JM 716648 | ▲ JM 716610 | 104 | 92 | 117 | 125 | 6 | 2.5 | 29.5 | 0.44 | 1.4 | 0.74 | 0.931 | 0.461 |
| ▲ JM 716649 | ▲ JM 716610 | 98 | 92 | 117 | 125 | 3 | 2.5 | 29.5 | 0.44 | 1.4 | 0.74 | 0.943 | 0.461 |
| ▲ JHM 516849 | ▲ JHM 516810 | 100 | 94 | 125 | 134 | 3 | 2.5 | 33.3 | 0.41 | 1.5 | 0.81 | 1.55 | 0.768 |
| ▲ JH 217249 | ▲ JH 217210 | 101 | 95 | 134 | 142 | 3 | 2.5 | 33.9 | 0.33 | 1.8 | 0.99 | 2.29 | 1.09 |
| 749 | 742 | 101 | 95 | 134 | 142 | 3.5 | 3.3 | 32.5 | 0.33 | 1.8 | 1.0 | 2.14 | 1.07 |
| 749 S | 742 | 104 | 95 | 134 | 142 | 5 | 3.3 | 32.5 | 0.33 | 1.8 | 1.0 | 2.14 | 1.07 |
| 497 | 492 A | 99 | 93 | 120 | 128 | 3.5 | 3.3 | 28.7 | 0.44 | 1.4 | 0.74 | 0.987 | 0.434 |
| 497 | 493 | 99 | 93 | 122 | 130 | 3.5 | 3.3 | 28.7 | 0.44 | 1.4 | 0.74 | 0.987 | 0.55 |
| HM 617049 | HM 617010 | 106 | 95 | 125 | 137 | 4.8 | 3.3 | 35.4 | 0.43 | 1.4 | 0.76 | 1.77 | 0.911 |
| 665 A | 653 | 107 | 95 | 131 | 139 | 6.4 | 3.3 | 33.2 | 0.41 | 1.5 | 0.81 | 1.71 | 0.891 |
| 665 | 653 | 102 | 95 | 131 | 139 | 3.5 | 3.3 | 33.2 | 0.41 | 1.5 | 0.81 | 1.72 | 0.891 |
| 596 | 592 A | 102 | 96 | 135 | 144 | 3.5 | 3.2 | 37.1 | 0.44 | 1.4 | 0.75 | 1.85 | 1.06 |
| 758 | 752 | 103 | 97 | 144 | 150 | 3.5 | 3.3 | 35.6 | 0.34 | 1.8 | 0.97 | 2.63 | 1.61 |
| 677 | 672 | 105 | 99 | 149 | 160 | 3.5 | 3.3 | 38.3 | 0.47 | 1.3 | 0.70 | 2.91 | 1.24 |
| HH 221432 | HH 221410 | 118 | 103 | 171 | 179 | 8 | 3.3 | 42.3 | 0.33 | 1.8 | 0.99 | 5.51 | 2.24 |
| 42350 | 42587 | 104 | 98 | 134 | 143 | 3 | 3.3 | 34.9 | 0.49 | 1.2 | 0.67 | 1.39 | 0.711 |
| 593 | 592 A | 104 | 98 | 135 | 144 | 3.5 | 3.2 | 37.1 | 0.44 | 1.4 | 0.75 | 1.73 | 1.06 |
| HM 518445 | HM 518410 | 107 | 96 | 137 | 148 | 6.4 | 3.3 | 33.1 | 0.40 | 1.5 | 0.82 | 2.11 | 0.776 |
| 759 | 752 | 106 | 99 | 144 | 150 | 3.5 | 3.3 | 35.6 | 0.34 | 1.8 | 0.97 | 2.47 | 1.61 |
| 766 | 752 | 113 | 99 | 144 | 150 | 7 | 3.3 | 35.6 | 0.34 | 1.8 | 0.97 | 2.45 | 1.61 |
| 6580 | 6535 | 109 | 102 | 141 | 154 | 3.5 | 3.3 | 40.7 | 0.40 | 1.5 | 0.82 | 3.03 | 1.67 |
| 759 | 753 | 106 | 99 | 147 | 150 | 3.5 | 3.3 | 35.6 | 0.34 | 1.8 | 0.97 | 2.47 | 2.1 |
| 850 | 832 | 106 | 100 | 149 | 155 | 3.5 | 3.3 | 35.2 | 0.30 | 2.0 | 1.1 | 3.39 | 1.74 |
| 855 | 854 | 118 | 103 | 170 | 174 | 8 | 3.3 | 41.8 | 0.33 | 1.8 | 0.99 | 4.99 | 2.55 |
| HH 221434 | HH 221410 | 120 | 105 | 171 | 179 | 8 | 3.3 | 42.3 | 0.33 | 1.8 | 0.99 | 5.41 | 2.24 |
| ▲ JM 718149 | ▲ JM 718110 | 105 | 99 | 131 | 139 | 3 | 2.5 | 33.0 | 0.44 | 1.4 | 0.74 | 1.49 | 0.66 |
| *HM 218248 | **HM 218210 | 111 | 98 | 133 | 141 | 7 | 3.5 | 30.8 | 0.33 | 1.8 | 0.99 | 1.77 | 0.796 |
| ▲ JHM 318448 | ▲ JHM 318410 | 106 | 100 | 140 | 148 | 3 | 2.5 | 34.1 | 0.34 | 1.7 | 0.96 | 2.32 | 1.01 |
| 760 | 752 | 107 | 101 | 144 | 150 | 3.5 | 3.3 | 35.6 | 0.34 | 1.8 | 0.97 | 2.38 | 1.61 |

**Notes**

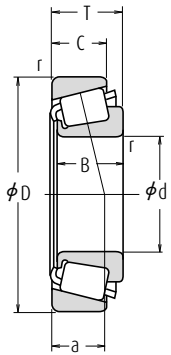
* The maximum bore diameter is listed and its tolerance is negative (See Table **7.4.1** on Page **A136**).

** The maximum outside diameter is listed and its tolerance is negative (See Table **7.4.2** on Pages **A136** and **A137**).

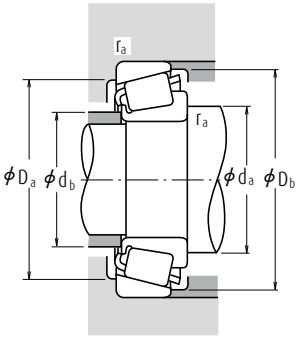
▲ The tolerances are listed in Tables **2, 3** and **4** on Pages **B202** and **B203**.

# Single-Row Tapered Roller Bearings (Inch Design)

## Bore Diameter 92.075 – 100.012 mm




| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Limiting Speeds ($min^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cone | Cup | | | | |
| d | D | T | B | C | r min. | | $C_r$ | $C_{0r}$ | Grease | Oil |
| **92.075** | 146.050 | 33.338 | 34.925 | 26.195 | 3.5 | 3.3 | 169 000 | 280 000 | 2 400 | 3 200 |
| | 148.430 | 28.575 | 28.971 | 21.433 | 3.5 | 3.0 | 140 000 | 218 000 | 2 200 | 3 000 |
| | 152.400 | 39.688 | 36.322 | 30.162 | 3.5 | 3.2 | 183 000 | 285 000 | 2 200 | 3 200 |
| | 152.400 | 39.688 | 36.322 | 30.162 | 6.4 | 3.2 | 183 000 | 285 000 | 2 200 | 3 200 |
| | 168.275 | 41.275 | 41.275 | 30.162 | 3.5 | 3.3 | 223 000 | 345 000 | 2 000 | 2 800 |
| | 190.500 | 57.150 | 57.531 | 44.450 | 8.0 | 3.3 | 355 000 | 500 000 | 1 900 | 2 600 |
| **93.662** | 148.430 | 28.575 | 28.971 | 21.433 | 3.0 | 3.0 | 140 000 | 218 000 | 2 200 | 3 000 |
| | 149.225 | 31.750 | 28.971 | 24.608 | 3.0 | 3.3 | 140 000 | 218 000 | 2 200 | 3 000 |
| | 152.400 | 39.688 | 36.322 | 30.162 | 3.5 | 3.2 | 183 000 | 285 000 | 2 200 | 3 200 |
| **95.000** | 150.000 | 35.000 | 34.000 | 27.000 | 3.0 | 2.5 | 183 000 | 285 000 | 2 200 | 3 200 |
| **95.250** | 146.050 | 33.338 | 34.925 | 26.195 | 3.5 | 3.3 | 169 000 | 280 000 | 2 400 | 3 200 |
| | 148.430 | 28.575 | 28.971 | 21.433 | 3.0 | 3.0 | 140 000 | 218 000 | 2 200 | 3 000 |
| | 149.225 | 31.750 | 28.971 | 24.608 | 3.5 | 3.3 | 140 000 | 218 000 | 2 200 | 3 000 |
| | 152.400 | 39.688 | 36.322 | 30.162 | 3.5 | 3.2 | 183 000 | 285 000 | 2 200 | 3 200 |
| | 152.400 | 39.688 | 36.322 | 33.338 | 3.5 | 3.3 | 183 000 | 285 000 | 2 200 | 3 200 |
| | 168.275 | 41.275 | 41.275 | 30.162 | 3.5 | 3.3 | 223 000 | 345 000 | 2 000 | 2 800 |
| | 171.450 | 47.625 | 48.260 | 38.100 | 3.5 | 3.3 | 282 000 | 415 000 | 2 000 | 2 800 |
| | 180.975 | 47.625 | 48.006 | 38.100 | 3.5 | 3.3 | 258 000 | 375 000 | 2 000 | 2 600 |
| | 190.500 | 57.150 | 57.531 | 44.450 | 8.0 | 3.3 | 355 000 | 500 000 | 1 900 | 2 600 |
| | 190.500 | 57.150 | 57.531 | 46.038 | 8.0 | 3.3 | 390 000 | 520 000 | 1 900 | 2 600 |
| **96.838** | 148.430 | 28.575 | 28.971 | 21.433 | 3.5 | 3.0 | 140 000 | 218 000 | 2 200 | 3 000 |
| | 149.225 | 31.750 | 28.971 | 24.606 | 3.5 | 3.3 | 140 000 | 218 000 | 2 200 | 3 000 |
| **98.425** | 161.925 | 36.512 | 36.116 | 26.195 | 3.5 | 3.3 | 191 000 | 310 000 | 2 000 | 2 800 |
| | 168.275 | 41.275 | 41.275 | 30.162 | 3.5 | 3.3 | 223 000 | 345 000 | 2 000 | 2 800 |
| | 180.975 | 47.625 | 48.006 | 38.100 | 3.5 | 3.3 | 258 000 | 375 000 | 2 000 | 2 600 |
| | 190.500 | 57.150 | 57.531 | 44.450 | 3.5 | 3.3 | 355 000 | 500 000 | 1 900 | 2 600 |
| | 190.500 | 57.150 | 57.531 | 46.038 | 3.5 | 3.3 | 390 000 | 520 000 | 1 900 | 2 600 |
| **99.982** | 190.500 | 57.150 | 57.531 | 46.038 | 6.4 | 3.3 | 390 000 | 520 000 | 1 900 | 2 600 |
| **100.000** | 150.000 | 32.000 | 30.000 | 26.000 | 2.3 | 2.3 | 146 000 | 235 000 | 2 200 | 3 000 |
| | 155.000 | 36.000 | 35.000 | 28.000 | 3.0 | 2.5 | 191 000 | 325 000 | 2 000 | 2 800 |
| | 160.000 | 41.000 | 40.000 | 32.000 | 3.0 | 2.5 | 239 000 | 380 000 | 2 000 | 2 800 |
| **100.012** | 157.162 | 36.512 | 36.116 | 26.195 | 3.5 | 3.3 | 191 000 | 310 000 | 2 000 | 2 800 |




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | 0 | 0.4 | $Y_1$ |

## Static Equivalent Load

$P_0=0.5F_r+Y_0F_a$

When $F_r>0.5F_r+Y_0F_a$, use $P_0=F_r$

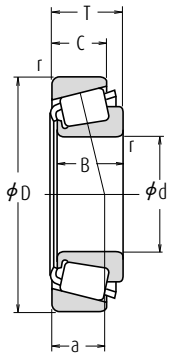
The values of e, $Y_1$ and $Y_0$ are given in the table below.

| Bearing Numbers | | Abutment and Fillet Dimensions (mm) | | | | | | Eff. Load Centers (mm) | Constant | Axial Load Factors | | Mass (kg) approx. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Cone | Cup | | | | | | |
| CONE | CUP | $d_a$ | $d_b$ | $D_a$ | $D_b$ | $r_a$ max. | | a | e | $Y_1$ | $Y_0$ | CONE | CUP |
| **47890** | **47820** | 107 | 101 | 131 | 140 | 3.5 | 3.3 | 32.3 | 0.45 | 1.3 | 0.74 | 1.46 | 0.664 |
| **42362** | **42584** | 107 | 101 | 134 | 142 | 3.5 | 3 | 31.8 | 0.49 | 1.2 | 0.67 | 1.29 | 0.553 |
| **598** | **592 A** | 107 | 101 | 135 | 144 | 3.5 | 3.2 | 37.1 | 0.44 | 1.4 | 0.75 | 1.6 | 1.06 |
| **598 A** | **592 A** | 113 | 101 | 135 | 144 | 6.4 | 3.2 | 37.1 | 0.44 | 1.4 | 0.75 | 1.59 | 1.06 |
| **681** | **672** | 110 | 104 | 149 | 160 | 3.5 | 3.3 | 38.3 | 0.47 | 1.3 | 0.70 | 2.62 | 1.24 |
| **857** | **854** | 121 | 106 | 170 | 174 | 8 | 3.3 | 41.8 | 0.33 | 1.8 | 0.99 | 4.78 | 2.55 |
| **42368** | **42584** | 107 | 102 | 134 | 142 | 3 | 3 | 31.8 | 0.49 | 1.2 | 0.67 | 1.24 | 0.553 |
| **42368** | **42587** | 107 | 102 | 134 | 143 | 3 | 3.3 | 34.9 | 0.49 | 1.2 | 0.67 | 1.24 | 0.711 |
| **597** | **592 A** | 109 | 102 | 135 | 144 | 3.5 | 3.2 | 37.1 | 0.44 | 1.4 | 0.75 | 1.54 | 1.06 |
| ▲ **JM 719149** | ▲ **JM 719113** | 109 | 104 | 135 | 143 | 3 | 2.5 | 33.4 | 0.44 | 1.4 | 0.75 | 1.46 | 0.765 |
| **47896** | **47820** | 110 | 103 | 131 | 140 | 3.5 | 3.3 | 32.3 | 0.45 | 1.3 | 0.74 | 1.33 | 0.664 |
| **42375** | **42584** | 108 | 103 | 134 | 142 | 3 | 3 | 31.8 | 0.49 | 1.2 | 0.67 | 1.18 | 0.553 |
| **42376** | **42587** | 109 | 103 | 134 | 143 | 3.5 | 3.3 | 34.9 | 0.49 | 1.2 | 0.67 | 1.18 | 0.711 |
| **594** | **592 A** | 110 | 104 | 135 | 144 | 3.5 | 3.2 | 37.1 | 0.44 | 1.4 | 0.75 | 1.47 | 1.06 |
| **594** | **592** | 109 | 103 | 135 | 145 | 3.5 | 3.3 | 37.1 | 0.44 | 1.4 | 0.75 | 1.47 | 1.12 |
| **683** | **672** | 113 | 106 | 149 | 160 | 3.5 | 3.3 | 38.3 | 0.47 | 1.3 | 0.70 | 2.47 | 1.24 |
| **77375** | **77675** | 117 | 105 | 152 | 159 | 3.5 | 3.3 | 37.8 | 0.37 | 1.6 | 0.90 | 2.91 | 1.67 |
| **776** | **772** | 114 | 107 | 161 | 168 | 3.5 | 3.3 | 39.1 | 0.39 | 1.6 | 0.86 | 3.25 | 1.99 |
| **864** | **854** | 123 | 108 | 170 | 174 | 8 | 3.3 | 41.8 | 0.33 | 1.8 | 0.99 | 4.57 | 2.55 |
| **HH 221440** | **HH 221410** | 125 | 110 | 171 | 179 | 8 | 3.3 | 42.3 | 0.33 | 1.8 | 0.99 | 5.0 | 2.24 |
| **42381** | **42584** | 110 | 104 | 134 | 142 | 3.5 | 3 | 31.8 | 0.49 | 1.2 | 0.67 | 1.13 | 0.553 |
| **42381** | **42587** | 111 | 105 | 135 | 143 | 3.5 | 3.3 | 34.9 | 0.49 | 1.2 | 0.67 | 1.13 | 0.711 |
| **52387** | **52637** | 114 | 108 | 144 | 154 | 3.5 | 3.3 | 36.1 | 0.47 | 1.3 | 0.69 | 1.89 | 0.942 |
| **685** | **672** | 116 | 109 | 149 | 160 | 3.5 | 3.3 | 38.3 | 0.47 | 1.3 | 0.70 | 2.32 | 1.24 |
| **779** | **772** | 116 | 110 | 161 | 168 | 3.5 | 3.3 | 39.1 | 0.39 | 1.6 | 0.86 | 3.06 | 1.99 |
| **866** | **854** | 118 | 111 | 170 | 174 | 3.5 | 3.3 | 41.8 | 0.33 | 1.8 | 0.99 | 4.38 | 2.55 |
| **HH 221442** | **HH 221410** | 119 | 113 | 171 | 179 | 3.5 | 3.3 | 42.3 | 0.33 | 1.8 | 0.99 | 4.81 | 2.24 |
| **HH 221447** | **HH 221410** | 126 | 114 | 171 | 179 | 6.4 | 3.3 | 42.3 | 0.33 | 1.8 | 0.99 | 4.68 | 2.24 |
| ▲ **JLM 820048** | ▲ **JLM 820012** | 111 | 107 | 135 | 144 | 2.3 | 2.3 | 36.8 | 0.50 | 1.2 | 0.66 | 1.27 | 0.616 |
| ▲ **JM 720249** | ▲ **JM 720210** | 115 | 109 | 140 | 149 | 3 | 2.5 | 36.8 | 0.47 | 1.3 | 0.70 | 1.68 | 0.772 |
| ▲ **JHM 720249** | ▲ **JHM 720210** | 117 | 109 | 143 | 154 | 3 | 2.5 | 38.2 | 0.47 | 1.3 | 0.70 | 2.09 | 0.974 |
| **52393** | **52618** | 116 | 109 | 142 | 152 | 3.5 | 3.3 | 36.1 | 0.47 | 1.3 | 0.69 | 1.81 | 0.702 |

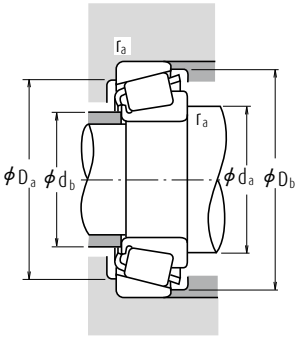
**Note** ▲ The tolerances are listed in Tables **2, 3** and **4** on Pages **B202** and **B203**.

# Single-Row Tapered Roller Bearings (Inch Design)

## Bore Diameter 101.600 – 117.475 mm




| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Limiting Speeds ($min^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cone | Cup | | | | |
| d | D | T | B | C | r min. | | $C_r$ | $C_{0r}$ | Grease | Oil |
| **101.600** | 157.162 | 36.512 | 36.116 | 26.195 | 3.5 | 3.3 | 191 000 | 310 000 | 2 000 | 2 800 |
| | 161.925 | 36.512 | 36.116 | 26.195 | 3.5 | 3.3 | 191 000 | 310 000 | 2 000 | 2 800 |
| | 168.275 | 41.275 | 41.275 | 30.162 | 3.5 | 3.3 | 223 000 | 345 000 | 2 000 | 2 800 |
| | 180.975 | 47.625 | 48.006 | 38.100 | 3.5 | 3.3 | 258 000 | 375 000 | 2 000 | 2 600 |
| | 190.500 | 57.150 | 57.531 | 44.450 | 8.0 | 3.3 | 355 000 | 500 000 | 1 900 | 2 600 |
| | 190.500 | 57.150 | 57.531 | 46.038 | 8.0 | 3.3 | 390 000 | 520 000 | 1 900 | 2 600 |
| | 212.725 | 66.675 | 66.675 | 53.975 | 7.0 | 3.3 | 570 000 | 810 000 | 1 700 | 2 200 |
| **104.775** | 180.975 | 47.625 | 48.006 | 38.100 | 7.0 | 3.3 | 258 000 | 375 000 | 2 000 | 2 600 |
| | 180.975 | 47.625 | 48.006 | 38.100 | 3.5 | 3.3 | 258 000 | 375 000 | 2 000 | 2 600 |
| | 190.500 | 47.625 | 49.212 | 34.925 | 3.5 | 3.3 | 296 000 | 465 000 | 1 800 | 2 400 |
| **106.362** | 165.100 | 36.512 | 36.512 | 26.988 | 3.5 | 3.3 | 195 000 | 320 000 | 2 000 | 2 600 |
| **107.950** | 158.750 | 23.020 | 21.438 | 15.875 | 3.5 | 3.3 | 102 000 | 165 000 | 2 000 | 2 800 |
| | 159.987 | 34.925 | 34.925 | 26.988 | 3.5 | 3.3 | 164 000 | 315 000 | 2 000 | 2 800 |
| | 161.925 | 34.925 | 34.925 | 26.988 | 3.5 | 3.3 | 164 000 | 280 000 | 2 000 | 2 800 |
| | 165.100 | 36.512 | 36.512 | 26.988 | 3.5 | 3.3 | 195 000 | 320 000 | 2 000 | 2 600 |
| | 190.500 | 47.625 | 49.212 | 34.925 | 3.5 | 3.3 | 296 000 | 465 000 | 1 800 | 2 400 |
| | 212.725 | 66.675 | 66.675 | 53.975 | 8.0 | 3.3 | 570 000 | 810 000 | 1 700 | 2 200 |
| **109.987** | 159.987 | 34.925 | 34.925 | 26.988 | 3.5 | 3.3 | 164 000 | 315 000 | 2 000 | 2 800 |
| | 159.987 | 34.925 | 34.925 | 26.988 | 8.0 | 3.3 | 164 000 | 315 000 | 2 000 | 2 800 |
| **109.992** | 177.800 | 41.275 | 41.275 | 30.162 | 3.5 | 3.3 | 232 000 | 375 000 | 1 800 | 2 600 |
| **110.000** | 165.000 | 35.000 | 35.000 | 26.500 | 3.0 | 2.5 | 195 000 | 320 000 | 2 000 | 2 600 |
| | 180.000 | 47.000 | 46.000 | 38.000 | 3.0 | 2.5 | 310 000 | 490 000 | 1 900 | 2 600 |
| **111.125** | 190.500 | 47.625 | 49.212 | 34.925 | 3.5 | 3.3 | 296 000 | 465 000 | 1 800 | 2 400 |
| **114.300** | 152.400 | 21.433 | 21.433 | 16.670 | 1.5 | 1.5 | 89 500 | 178 000 | 2 000 | 2 800 |
| | 177.800 | 41.275 | 41.275 | 30.162 | 3.5 | 3.3 | 232 000 | 375 000 | 1 800 | 2 600 |
| | 180.000 | 34.925 | 31.750 | 25.400 | 3.5 | 0.8 | 174 000 | 254 000 | 1 800 | 2 400 |
| | 190.500 | 47.625 | 49.212 | 34.925 | 3.5 | 3.3 | 296 000 | 465 000 | 1 800 | 2 400 |
| | 212.725 | 66.675 | 66.675 | 53.975 | 7.0 | 3.3 | 475 000 | 700 000 | 1 700 | 2 400 |
| | 212.725 | 66.675 | 66.675 | 53.975 | 7.0 | 3.3 | 570 000 | 810 000 | 1 700 | 2 200 |
| **115.087** | 190.500 | 47.625 | 49.212 | 34.925 | 3.5 | 3.3 | 296 000 | 465 000 | 1 800 | 2 400 |
| **117.475** | 180.975 | 34.925 | 31.750 | 25.400 | 3.5 | 3.3 | 174 000 | 254 000 | 1 800 | 2 400 |




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | 0 | 0.4 | $Y_1$ |

## Static Equivalent Load

$P_0=0.5F_r+Y_0F_a$

When $F_r>0.5F_r+Y_0F_a$, use $P_0=F_r$

The values of e, $Y_1$ and $Y_0$ are given in the table below.

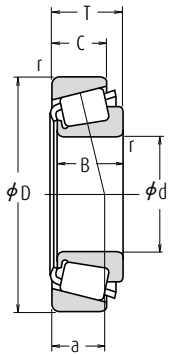
| Bearing Numbers | | Abutment and Fillet Dimensions (mm) | | | | | | Eff. Load Centers (mm) | Constant | Axial Load Factors | | Mass (kg) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Cone | Cup | | | | | approx. | |
| CONE | CUP | $d_a$ | $d_b$ | $D_a$ | $D_b$ | $r_a$ max. | | a | e | $Y_1$ | $Y_0$ | CONE | CUP |
| 52400 | 52618 | 117 | 111 | 142 | 152 | 3.5 | 3.3 | 36.1 | 0.47 | 1.3 | 0.69 | 1.75 | 0.702 |
| 52400 | 52637 | 117 | 111 | 144 | 154 | 3.5 | 3.3 | 36.1 | 0.47 | 1.3 | 0.69 | 1.75 | 0.942 |
| 687 | 672 | 118 | 112 | 149 | 160 | 3.5 | 3.3 | 38.3 | 0.47 | 1.3 | 0.70 | 2.15 | 1.24 |
| 780 | 772 | 119 | 113 | 161 | 168 | 3.5 | 3.3 | 39.1 | 0.39 | 1.6 | 0.86 | 2.88 | 1.99 |
| 861 | 854 | 129 | 114 | 170 | 174 | 8 | 3.3 | 41.8 | 0.33 | 1.8 | 0.99 | 4.13 | 2.55 |
| HH 221449 | HH 221410 | 131 | 116 | 171 | 179 | 8 | 3.3 | 42.3 | 0.33 | 1.8 | 0.99 | 4.55 | 2.24 |
| HH 224335 | HH 224310 | 132 | 121 | 192 | 202 | 7 | 3.3 | 47.3 | 0.33 | 1.8 | 1.0 | 8.14 | 3.06 |
| 787 | 772 | 129 | 116 | 161 | 168 | 7 | 3.3 | 39.1 | 0.39 | 1.6 | 0.86 | 2.66 | 1.99 |
| 782 | 772 | 122 | 116 | 161 | 168 | 3.5 | 3.3 | 39.1 | 0.39 | 1.6 | 0.86 | 2.68 | 1.99 |
| 71412 | 71750 | 124 | 118 | 171 | 181 | 3.5 | 3.3 | 40.1 | 0.42 | 1.4 | 0.79 | 4.0 | 1.71 |
| 56418 | 56650 | 122 | 116 | 149 | 159 | 3.5 | 3.3 | 38.6 | 0.50 | 1.2 | 0.66 | 1.87 | 0.861 |
| 37425 | 37625 | 122 | 115 | 143 | 152 | 3.5 | 3.3 | 37.0 | 0.61 | 0.99 | 0.54 | 0.886 | 0.488 |
| LM 522546 | LM 522510 | 122 | 116 | 146 | 154 | 3.5 | 3.3 | 33.7 | 0.40 | 1.5 | 0.82 | 1.65 | 0.784 |
| 48190 | 48120 | 122 | 116 | 146 | 156 | 3.5 | 3.3 | 38.7 | 0.51 | 1.2 | 0.65 | 1.59 | 0.83 |
| 56425 | 56650 | 123 | 117 | 149 | 159 | 3.5 | 3.3 | 38.6 | 0.50 | 1.2 | 0.66 | 1.8 | 0.861 |
| 71425 | 71750 | 126 | 120 | 171 | 181 | 3.5 | 3.3 | 40.1 | 0.42 | 1.4 | 0.79 | 3.79 | 1.71 |
| HH 224340 | HH 224310 | 139 | 126 | 192 | 202 | 8 | 3.3 | 47.3 | 0.33 | 1.8 | 1.0 | 7.58 | 3.06 |
| LM 522549 | LM 522510 | 124 | 118 | 146 | 154 | 3.5 | 3.3 | 33.7 | 0.40 | 1.5 | 0.82 | 1.55 | 0.784 |
| LM 522548 | LM 522510 | 133 | 118 | 146 | 154 | 8 | 3.3 | 33.7 | 0.40 | 1.5 | 0.82 | 1.53 | 0.784 |
| 64433 | 64700 | 128 | 121 | 160 | 172 | 3.5 | 3.3 | 42.4 | 0.52 | 1.2 | 0.64 | 2.64 | 1.11 |
| ▲ JM 822049 | ▲ JM 822010 | 124 | 119 | 149 | 159 | 3 | 2.5 | 38.3 | 0.50 | 1.2 | 0.66 | 1.64 | 0.842 |
| ▲ JHM 522649 | ▲ JHM 522610 | 127 | 122 | 162 | 172 | 3 | 2.5 | 40.9 | 0.41 | 1.5 | 0.81 | 3.12 | 1.51 |
| 71437 | 71750 | 129 | 123 | 171 | 181 | 3.5 | 3.3 | 40.1 | 0.42 | 1.4 | 0.79 | 3.58 | 1.71 |
| L 623149 | L 623110 | 123 | 121 | 143 | 148 | 1.5 | 1.5 | 27.4 | 0.41 | 1.5 | 0.80 | 0.725 | 0.344 |
| 64450 | 64700 | 131 | 125 | 160 | 172 | 3.5 | 3.3 | 42.4 | 0.52 | 1.2 | 0.64 | 2.39 | 1.11 |
| 68450 | ** 68709 | 130 | 123 | 165 | 172 | 3.5 | 0.8 | 40.0 | 0.50 | 1.2 | 0.66 | 1.95 | 1.0 |
| 71450 | 71750 | 132 | 125 | 171 | 181 | 3.5 | 3.3 | 40.1 | 0.42 | 1.4 | 0.79 | 3.37 | 1.71 |
| 938 | 932 | 141 | 128 | 187 | 193 | 7 | 3.3 | 46.9 | 0.33 | 1.8 | 1.0 | 6.01 | 4.11 |
| HH 224346 | HH 224310 | 143 | 131 | 192 | 202 | 7 | 3.3 | 47.3 | 0.33 | 1.8 | 1.0 | 7.01 | 3.06 |
| 71453 | 71750 | 133 | 126 | 171 | 181 | 3.5 | 3.3 | 40.1 | 0.42 | 1.4 | 0.79 | 3.31 | 1.71 |
| 68462 | 68712 | 132 | 125 | 163 | 172 | 3.5 | 3.3 | 40.0 | 0.50 | 1.2 | 0.66 | 1.73 | 1.05 |

**Notes** ** The maximum outside diameter is listed and its tolerance is negative (See Table **7.4.2** on Pages **A136** and **A137**).

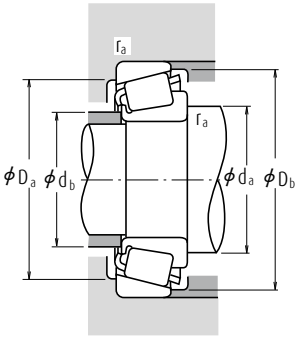
▲ The tolerances are listed in Tables **2, 3** and **4** on Pages **B202** and **B203**.

# Single-Row Tapered Roller Bearings (Inch Design)

## Bore Diameter 120.000 – 165.100 mm




| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Limiting Speeds (min$^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cone | Cup | | | | |
| d | D | T | B | C | r min. | | $C_r$ | $C_{0r}$ | Grease | Oil |
| **120.000** | 170.000 | 25.400 | 25.400 | 19.050 | 3.3 | 3.3 | 130 000 | 219 000 | 1 900 | 2 600 |
| | 174.625 | 35.720 | 36.512 | 27.783 | 3.5 | 1.5 | 212 000 | 385 000 | 1 900 | 2 600 |
| **120.650** | 182.562 | 39.688 | 38.100 | 33.338 | 3.5 | 3.3 | 228 000 | 445 000 | 1 800 | 2 400 |
| | 206.375 | 47.625 | 47.625 | 34.925 | 3.3 | 3.3 | 320 000 | 530 000 | 1 600 | 2 200 |
| **123.825** | 182.562 | 39.688 | 38.100 | 33.338 | 3.5 | 3.3 | 228 000 | 445 000 | 1 800 | 2 400 |
| **125.000** | 175.000 | 25.400 | 25.400 | 18.288 | 3.3 | 3.3 | 134 000 | 232 000 | 1 800 | 2 400 |
| **127.000** | 165.895 | 18.258 | 17.462 | 13.495 | 1.5 | 1.5 | 84 500 | 149 000 | 1 900 | 2 600 |
| | 182.562 | 39.688 | 38.100 | 33.338 | 3.5 | 3.3 | 228 000 | 445 000 | 1 800 | 2 400 |
| | 196.850 | 46.038 | 46.038 | 38.100 | 3.5 | 3.3 | 315 000 | 560 000 | 1 700 | 2 200 |
| | 215.900 | 47.625 | 47.625 | 34.925 | 3.5 | 3.3 | 287 000 | 495 000 | 1 500 | 2 000 |
| **128.588** | 206.375 | 47.625 | 47.625 | 34.925 | 3.3 | 3.3 | 320 000 | 530 000 | 1 600 | 2 200 |
| **130.000** | 206.375 | 47.625 | 47.625 | 34.925 | 3.5 | 3.3 | 320 000 | 530 000 | 1 600 | 2 200 |
| **130.175** | 203.200 | 46.038 | 46.038 | 38.100 | 3.5 | 3.3 | 315 000 | 560 000 | 1 700 | 2 200 |
| | 206.375 | 47.625 | 47.625 | 34.925 | 3.5 | 3.3 | 320 000 | 530 000 | 1 600 | 2 200 |
| **133.350** | 177.008 | 25.400 | 26.195 | 20.638 | 1.5 | 1.5 | 124 000 | 258 000 | 1 800 | 2 400 |
| | 190.500 | 39.688 | 39.688 | 33.338 | 3.5 | 3.3 | 240 000 | 485 000 | 1 700 | 2 200 |
| | 196.850 | 46.038 | 46.038 | 38.100 | 3.5 | 3.3 | 315 000 | 560 000 | 1 700 | 2 200 |
| | 215.900 | 47.625 | 47.625 | 34.925 | 3.5 | 3.3 | 287 000 | 495 000 | 1 500 | 2 000 |
| **136.525** | 190.500 | 39.688 | 39.688 | 33.338 | 3.5 | 3.3 | 216 000 | 440 000 | 1 700 | 2 200 |
| | 217.488 | 47.625 | 47.625 | 34.925 | 3.5 | 3.3 | 287 000 | 495 000 | 1 500 | 2 000 |
| **139.700** | 187.325 | 28.575 | 29.370 | 23.020 | 1.5 | 1.5 | 153 000 | 305 000 | 1 700 | 2 200 |
| | 215.900 | 47.625 | 47.625 | 34.925 | 3.5 | 3.3 | 287 000 | 495 000 | 1 500 | 2 000 |
| | 254.000 | 66.675 | 66.675 | 47.625 | 7.0 | 3.3 | 515 000 | 830 000 | 1 300 | 1 800 |
| **142.875** | 200.025 | 41.275 | 39.688 | 34.130 | 3.5 | 3.3 | 227 000 | 460 000 | 1 600 | 2 200 |
| **146.050** | 193.675 | 28.575 | 28.575 | 23.020 | 1.5 | 1.5 | 170 000 | 355 000 | 1 600 | 2 200 |
| | 236.538 | 57.150 | 56.642 | 44.450 | 3.5 | 3.3 | 455 000 | 720 000 | 1 400 | 1 900 |
| | 254.000 | 66.675 | 66.675 | 47.625 | 7.0 | 3.3 | 515 000 | 830 000 | 1 300 | 1 800 |
| **149.225** | 254.000 | 66.675 | 66.675 | 47.625 | 7.0 | 3.3 | 515 000 | 830 000 | 1 300 | 1 800 |
| **152.400** | 254.000 | 66.675 | 66.675 | 47.625 | 7.0 | 3.3 | 515 000 | 830 000 | 1 300 | 1 800 |
| **158.750** | 225.425 | 41.275 | 39.688 | 33.338 | 3.5 | 3.3 | 240 000 | 540 000 | 1 400 | 1 900 |
| **165.100** | 247.650 | 47.625 | 47.625 | 38.100 | 3.5 | 3.3 | 345 000 | 705 000 | 1 300 | 1 700 |




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | 0 | 0.4 | $Y_1$ |

## Static Equivalent Load

$P_0=0.5F_r+Y_0F_a$

When $F_r>0.5F_r+Y_0F_a$, use $P_0=F_r$

The values of e, $Y_1$ and $Y_0$ are given in the table below.

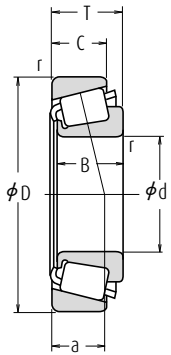
| Bearing Numbers | | Abutment and Fillet Dimensions (mm) | | | | | | Eff. Load Centers (mm) | Constant | Axial Load Factors | | Mass (kg) approx. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Cone | Cup | | | | | | |
| CONE | CUP | $d_a$ | $d_b$ | $D_a$ | $D_b$ | $r_a$ max. | | a | e | $Y_1$ | $Y_0$ | CONE | CUP |
| ▲ JL 724348 | ▲ JL 724314 | 132 | 127 | 156 | 163 | 3.3 | 3.3 | 32.9 | 0.46 | 1.3 | 0.72 | 1.08 | 0.591 |
| * M 224748 | M 224710 | 135 | 129 | 163 | 168 | 3.5 | 1.5 | 32.2 | 0.33 | 1.8 | 0.99 | 1.9 | 0.866 |
| 48282 | 48220 | 136 | 133 | 168 | 176 | 3.5 | 3.3 | 34.2 | 0.31 | 2.0 | 1.1 | 2.56 | 1.14 |
| 795 | 792 | 139 | 134 | 186 | 198 | 3.3 | 3.3 | 45.7 | 0.46 | 1.3 | 0.72 | 4.44 | 1.9 |
| 48286 | 48220 | 139 | 133 | 168 | 176 | 3.5 | 3.3 | 34.2 | 0.31 | 2.0 | 1.1 | 2.37 | 1.14 |
| ▲ JL 725346 | ▲ JL 725316 | 138 | 133 | 161 | 168 | 3.3 | 3.3 | 34.3 | 0.48 | 1.3 | 0.69 | 1.19 | 0.573 |
| LL 225749 | LL 225710 | 135 | 132 | 158 | 160 | 1.5 | 1.5 | 24.2 | 0.33 | 1.8 | 0.99 | 0.647 | 0.288 |
| 48290 | 48220 | 141 | 135 | 168 | 176 | 3.5 | 3.3 | 34.2 | 0.31 | 2.0 | 1.1 | 2.19 | 1.14 |
| 67388 | 67322 | 144 | 138 | 180 | 189 | 3.5 | 3.3 | 39.7 | 0.34 | 1.7 | 0.96 | 3.74 | 1.46 |
| 74500 | 74850 | 148 | 141 | 196 | 208 | 3.5 | 3.3 | 48.4 | 0.49 | 1.2 | 0.68 | 4.92 | 1.99 |
| 799 | 792 | 146 | 140 | 186 | 198 | 3.3 | 3.3 | 45.7 | 0.46 | 1.3 | 0.72 | 3.86 | 1.9 |
| 797 | 792 | 148 | 141 | 186 | 198 | 3.5 | 3.3 | 45.7 | 0.46 | 1.3 | 0.72 | 3.76 | 1.9 |
| 67389 | 67320 | 146 | 141 | 183 | 191 | 3.5 | 3.3 | 39.7 | 0.34 | 1.7 | 0.96 | 3.51 | 2.06 |
| 799 A | 792 | 148 | 142 | 186 | 198 | 3.5 | 3.3 | 45.7 | 0.46 | 1.3 | 0.72 | 3.74 | 1.9 |
| L 327249 | L 327210 | 143 | 141 | 167 | 171 | 1.5 | 1.5 | 29.5 | 0.35 | 1.7 | 0.95 | 1.18 | 0.55 |
| 48385 | 48320 | 148 | 142 | 177 | 184 | 3.5 | 3.3 | 35.9 | 0.32 | 1.9 | 1.0 | 2.58 | 1.16 |
| 67390 | 67322 | 149 | 143 | 180 | 189 | 3.5 | 3.3 | 39.7 | 0.34 | 1.7 | 0.96 | 3.27 | 1.46 |
| 74525 | 74850 | 152 | 146 | 196 | 208 | 3.5 | 3.3 | 48.4 | 0.49 | 1.2 | 0.68 | 4.44 | 1.99 |
| 48393 | 48320 | 151 | 144 | 177 | 184 | 3.5 | 3.3 | 35.9 | 0.32 | 1.9 | 1.0 | 2.31 | 1.16 |
| 74537 | 74856 | 155 | 148 | 197 | 210 | 3.5 | 3.3 | 48.4 | 0.49 | 1.2 | 0.68 | 4.19 | 2.13 |
| LM 328448 | LM 328410 | 149 | 147 | 176 | 182 | 1.5 | 1.5 | 31.7 | 0.36 | 1.7 | 0.93 | 1.59 | 0.67 |
| 74550 | 74850 | 158 | 151 | 196 | 208 | 3.5 | 3.3 | 48.4 | 0.49 | 1.2 | 0.68 | 3.93 | 1.99 |
| 99550 | 99100 | 170 | 156 | 227 | 238 | 7 | 3.3 | 55.3 | 0.41 | 1.5 | 0.81 | 9.99 | 3.83 |
| 48685 | 48620 | 158 | 151 | 185 | 193 | 3.5 | 3.3 | 37.6 | 0.34 | 1.8 | 0.98 | 2.63 | 1.19 |
| 36690 | 36620 | 155 | 154 | 182 | 188 | 1.5 | 1.5 | 33.5 | 0.37 | 1.6 | 0.90 | 1.64 | 0.725 |
| HM 231140 | HM 231110 | 164 | 160 | 217 | 224 | 3.5 | 3.3 | 45.9 | 0.32 | 1.9 | 1.0 | 6.07 | 2.93 |
| 99575 | 99100 | 175 | 162 | 227 | 238 | 7 | 3.3 | 55.3 | 0.41 | 1.5 | 0.81 | 9.24 | 3.83 |
| 99587 | 99100 | 178 | 165 | 227 | 238 | 7 | 3.3 | 55.3 | 0.41 | 1.5 | 0.81 | 8.86 | 3.83 |
| 99600 | 99100 | 181 | 167 | 227 | 238 | 7 | 3.3 | 55.3 | 0.41 | 1.5 | 0.81 | 8.46 | 3.83 |
| 46780 | 46720 | 176 | 169 | 209 | 218 | 3.5 | 3.3 | 44.3 | 0.38 | 1.6 | 0.86 | 3.69 | 1.66 |
| 67780 | 67720 | 185 | 179 | 229 | 240 | 3.5 | 3.3 | 52.4 | 0.44 | 1.4 | 0.75 | 5.83 | 2.33 |

**Notes** * The maximum bore diameter is listed and its tolerance is negative (See Table **7.4.1** on Page **A136**).

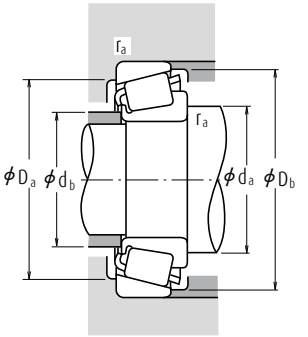
▲ The tolerances are listed in Tables **2, 3** and **4** on Pages **B202** and **B203**.

# Single-Row Tapered Roller Bearings (Inch Design)

## Bore Diameter 170.000 – 206.375 mm




| Boundary Dimensions (mm) | | | | | | | Basic Load Ratings (N) | | Limiting Speeds (min$^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cone | Cup | | | | |
| d | D | T | B | C | r min. | | $C_r$ | $C_{0r}$ | Grease | Oil |
| **170.000** | 230.000 | 39.000 | 38.000 | 31.000 | 3.0 | 2.5 | 278 000 | 520 000 | 1 300 | 1 800 |
| | 240.000 | 46.000 | 44.500 | 37.000 | 3.0 | 2.5 | 380 000 | 720 000 | 1 300 | 1 800 |
| **174.625** | 247.650 | 47.625 | 47.625 | 38.100 | 3.5 | 3.3 | 345 000 | 705 000 | 1 300 | 1 700 |
| **177.800** | 227.012 | 30.162 | 30.162 | 23.020 | 1.5 | 1.5 | 181 000 | 415 000 | 1 300 | 1 800 |
| | 247.650 | 47.625 | 47.625 | 38.100 | 3.5 | 3.3 | 345 000 | 705 000 | 1 300 | 1 700 |
| | 260.350 | 53.975 | 53.975 | 41.275 | 3.5 | 3.3 | 455 000 | 835 000 | 1 200 | 1 700 |
| **190.000** | 260.000 | 46.000 | 44.000 | 36.500 | 3.0 | 2.5 | 370 000 | 730 000 | 1 100 | 1 600 |
| **190.500** | 266.700 | 47.625 | 46.833 | 38.100 | 3.5 | 3.3 | 345 000 | 720 000 | 1 100 | 1 500 |
| **200.000** | 300.000 | 65.000 | 62.000 | 51.000 | 3.5 | 2.5 | 615 000 | 1 130 000 | 1 000 | 1 400 |
| **203.200** | 282.575 | 46.038 | 46.038 | 36.512 | 3.5 | 3.3 | 365 000 | 800 000 | 1 000 | 1 400 |
| **206.375** | 282.575 | 46.038 | 46.038 | 36.512 | 3.5 | 3.3 | 365 000 | 800 000 | 1 000 | 1 400 |




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | 0 | 0.4 | $Y_1$ |

## Static Equivalent Load

$P_0=0.5F_r+Y_0F_a$

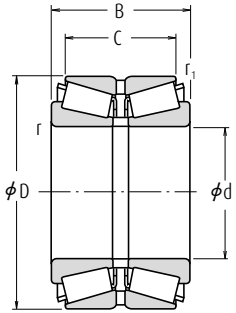
When $F_r>0.5F_r+Y_0F_a$, use $P_0=F_r$

The values of e, $Y_1$ and $Y_0$ are given in the table below.

| Bearing Numbers | | Abutment and Fillet Dimensions (mm) | | | | | | Eff. Load Centers (mm) | Constant | Axial Load Factors | | Mass (kg) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Cone | Cup | | | | | approx. | |
| CONE | CUP | $d_a$ | $d_b$ | $D_a$ | $D_b$ | $r_a$ max. | | a | e | $Y_1$ | $Y_0$ | CONE | CUP |
| ▲ JHM 534149 | ▲ JHM 534110 | 184 | 178 | 217 | 224 | 3 | 2.5 | 43.2 | 0.38 | 1.6 | 0.86 | 3.1 | 1.3 |
| ▲ JM 734449 | ▲ JM 734410 | 185 | 180 | 222 | 232 | 3 | 2.5 | 50.5 | 0.44 | 1.4 | 0.75 | 4.42 | 2.02 |
| 67787 | 67720 | 192 | 185 | 229 | 240 | 3.5 | 3.3 | 52.4 | 0.44 | 1.4 | 0.75 | 4.88 | 2.33 |
| 36990 | 36920 | 189 | 186 | 214 | 221 | 1.5 | 1.5 | 42.9 | 0.44 | 1.4 | 0.75 | 2.1 | 0.907 |
| 67790 | 67720 | 194 | 188 | 229 | 240 | 3.5 | 3.3 | 52.4 | 0.44 | 1.4 | 0.75 | 4.56 | 2.33 |
| M 236849 | M 236810 | 195 | 192 | 241 | 249 | 3.5 | 3.3 | 47.5 | 0.33 | 1.8 | 0.99 | 6.49 | 2.86 |
| ▲ JM 738249 | ▲ JM 738210 | 206 | 200 | 242 | 252 | 3 | 2.5 | 56.4 | 0.48 | 1.3 | 0.69 | 4.73 | 2.2 |
| 67885 | 67820 | 209 | 203 | 246 | 259 | 3.5 | 3.3 | 57.9 | 0.48 | 1.3 | 0.69 | 5.4 | 2.64 |
| ▲ JHM 840449 | ▲ JHM 840410 | 223 | 215 | 273 | 289 | 3.5 | 2.5 | 73.1 | 0.52 | 1.2 | 0.63 | 10.3 | 5.19 |
| 67983 | 67920 | 222 | 216 | 260 | 275 | 3.5 | 3.3 | 61.9 | 0.51 | 1.2 | 0.65 | 6.03 | 2.82 |
| 67985 | 67920 | 224 | 219 | 260 | 275 | 3.5 | 3.3 | 61.9 | 0.51 | 1.2 | 0.65 | 5.66 | 2.82 |

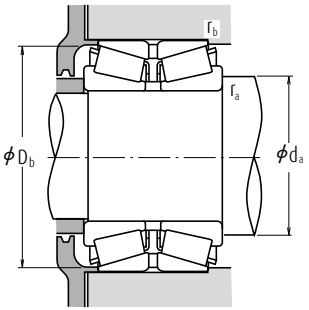
Note ▲ The tolerances are listed in Tables **2, 3** and **4** on Pages **B202** and **B203**.

## Bore Diameter 40 – 90 mm




| Boundary Dimensions (mm) | | | | | | Basic Load Ratings (N) | | Limiting Speeds (min⁻¹) | |
|---|---|---|---|---|---|---|---|---|---|
| d | D | $B_2$ | C | r min. | $r_1$ min. | $C_r$ | $C_{0r}$ | Grease | Oil |
| **40** | 80 | 45 | 37.5 | 1.5 | 0.6 | 109 000 | 140 000 | 3 700 | 5 100 |
| **45** | 85 | 47 | 37.5 | 1.5 | 0.6 | 117 000 | 159 000 | 3 400 | 4 700 |
| | 85 | 55 | 43.5 | 1.5 | 0.6 | 143 000 | 204 000 | 3 400 | 4 700 |
| **50** | 90 | 48 | 38.5 | 1.5 | 0.6 | 131 000 | 183 000 | 3 200 | 4 400 |
| | 90 | 49 | 39.5 | 1.5 | 0.6 | 131 000 | 183 000 | 3 200 | 4 400 |
| | 90 | 55 | 43.5 | 1.5 | 0.6 | 150 000 | 218 000 | 3 200 | 4 400 |
| | 110 | 64 | 51.5 | 2.5 | 0.6 | 224 000 | 297 000 | 2 700 | 3 700 |
| **55** | 100 | 51 | 41.5 | 2 | 0.6 | 162 000 | 226 000 | 2 900 | 3 900 |
| | 100 | 52 | 42.5 | 2 | 0.6 | 162 000 | 226 000 | 2 900 | 3 900 |
| | 100 | 60 | 48.5 | 2 | 0.6 | 188 000 | 274 000 | 2 900 | 3 900 |
| | 120 | 70 | 57 | 2.5 | 0.6 | 256 000 | 342 000 | 2 500 | 3 400 |
| **60** | 110 | 53 | 43.5 | 2 | 0.6 | 178 000 | 246 000 | 2 700 | 3 600 |
| | 110 | 66 | 54.5 | 2 | 0.6 | 225 000 | 335 000 | 2 700 | 3 600 |
| | 130 | 74 | 59 | 3 | 1 | 298 000 | 405 000 | 2 300 | 3 200 |
| **65** | 120 | 56 | 46.5 | 2 | 0.6 | 210 000 | 300 000 | 2 400 | 3 200 |
| | 120 | 57 | 47.5 | 2 | 0.6 | 210 000 | 300 000 | 2 400 | 3 200 |
| | 120 | 73 | 61.5 | 2 | 0.6 | 269 000 | 405 000 | 2 400 | 3 300 |
| **65** | 140 | 79 | 63 | 3 | 1 | 340 000 | 465 000 | 2 100 | 2 900 |
| **70** | 125 | 57 | 46.5 | 2 | 0.6 | 227 000 | 325 000 | 2 300 | 3 100 |
| | 125 | 59 | 48.5 | 2 | 0.6 | 227 000 | 325 000 | 2 300 | 3 100 |
| | 125 | 74 | 61.5 | 2 | 0.6 | 270 000 | 410 000 | 2 300 | 3 100 |
| | 150 | 83 | 67 | 3 | 1 | 390 000 | 535 000 | 2 000 | 2 700 |
| **75** | 130 | 62 | 51.5 | 2 | 0.6 | 245 000 | 365 000 | 2 200 | 3 000 |
| | 130 | 74 | 61.5 | 2 | 0.6 | 283 000 | 440 000 | 2 200 | 3 000 |
| | 160 | 87 | 69 | 3 | 1 | 435 000 | 600 000 | 1 900 | 2 500 |
| **80** | 140 | 61 | 49 | 2.5 | 0.6 | 269 000 | 390 000 | 2 000 | 2 800 |
| | 140 | 64 | 51.5 | 2.5 | 0.6 | 269 000 | 390 000 | 2 000 | 2 800 |
| | 140 | 78 | 63.5 | 2.5 | 0.6 | 330 000 | 505 000 | 2 000 | 2 800 |
| | 170 | 92 | 73 | 3 | 1 | 475 000 | 655 000 | 1 700 | 2 400 |
| **85** | 150 | 70 | 57 | 2.5 | 0.6 | 315 000 | 465 000 | 1 900 | 2 600 |
| | 150 | 86 | 69 | 2.5 | 0.6 | 360 000 | 555 000 | 1 900 | 2 600 |
| | 180 | 98 | 77 | 4 | 1 | 530 000 | 745 000 | 1 600 | 2 200 |
| **90** | 160 | 71 | 58 | 2.5 | 0.6 | 345 000 | 510 000 | 1 800 | 2 400 |
| | 160 | 74 | 61 | 2.5 | 0.6 | 345 000 | 510 000 | 1 800 | 2 400 |
| | 160 | 94 | 77 | 2.5 | 0.6 | 440 000 | 700 000 | 1 800 | 2 400 |

**Remark** For other double-row tapered roller bearings not listed above, please contact NSK.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | $Y_3$ | 0.67 | $Y_2$ |

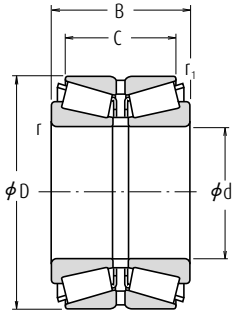
## Static Equivalent Load

$P_0=F_r+Y_0F_a$

The values of e, $Y_2$ , $Y_3$ and $Y_0$ are given in the table below.

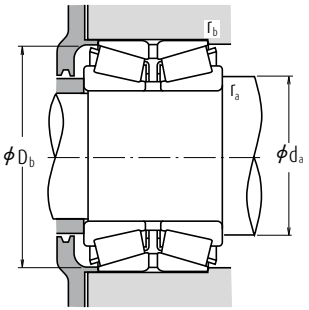
| Bearing Numbers | Abutment and Fillet Dimensions (mm) | | | | Constant | Axial Load Factors | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|
| | $d_a$ min. | $D_b$ min. | $r_a$ max. | $r_b$ max. | e | $Y_2$ | $Y_3$ | $Y_0$ | approx. |
| HR 40 KBE 42+L | 51 | 75 | 1.5 | 0.6 | 0.37 | 2.7 | 1.8 | 1.8 | 0.97 |
| HR 45 KBE 42+L | 56 | 81 | 1.5 | 0.6 | 0.40 | 2.5 | 1.7 | 1.6 | 1.08 |
| HR 45 KBE 52X+L | 56 | 81 | 1.5 | 0.6 | 0.40 | 2.5 | 1.7 | 1.6 | 1.31 |
| HR 50 KBE 042+L | 61 | 87 | 1.5 | 0.6 | 0.42 | 2.4 | 1.6 | 1.6 | 1.20 |
| HR 50 KBE 42+L | 61 | 87 | 1.5 | 0.6 | 0.42 | 2.4 | 1.6 | 1.6 | 1.22 |
| HR 50 KBE 52X+L | 61 | 87 | 1.5 | 0.6 | 0.42 | 2.4 | 1.6 | 1.6 | 1.39 |
| HR 50 KBE 043+L | 65 | 104 | 2 | 0.6 | 0.35 | 2.9 | 2.0 | 1.9 | 2.77 |
| HR 55 KBE 042+L | 67 | 96 | 2 | 0.6 | 0.40 | 2.5 | 1.7 | 1.6 | 1.59 |
| HR 55 KBE 1003+L | 67 | 96 | 2 | 0.6 | 0.40 | 2.5 | 1.7 | 1.6 | 1.63 |
| HR 55 KBE 52X+L | 67 | 97 | 2 | 0.6 | 0.40 | 2.5 | 1.7 | 1.6 | 1.88 |
| HR 55 KBE 43+L | 70 | 113 | 2 | 0.6 | 0.35 | 2.9 | 2.0 | 1.9 | 3.52 |
| HR 60 KBE 042+L | 72 | 105 | 2 | 0.6 | 0.40 | 2.5 | 1.7 | 1.6 | 2.03 |
| HR 60 KBE 52X+L | 72 | 106 | 2 | 0.6 | 0.40 | 2.5 | 1.7 | 1.6 | 2.52 |
| HR 60 KBE 43+L | 78 | 122 | 2.5 | 1 | 0.35 | 2.9 | 2.0 | 1.9 | 4.40 |
| HR 65 KBE 42+L | 77 | 115 | 2 | 0.6 | 0.40 | 2.5 | 1.7 | 1.6 | 2.58 |
| HR 65 KBE 1202+L | 77 | 115 | 2 | 0.6 | 0.40 | 2.5 | 1.7 | 1.6 | 2.61 |
| HR 65 KBE 52X+L | 77 | 117 | 2 | 0.6 | 0.40 | 2.5 | 1.7 | 1.6 | 3.35 |
| HR 65 KBE 43+L | 83 | 132 | 2.5 | 1 | 0.35 | 2.9 | 2.0 | 1.9 | 5.42 |
| HR 70 KBE 042+L | 82 | 120 | 2 | 0.6 | 0.42 | 2.4 | 1.6 | 1.6 | 2.79 |
| HR 70 KBE 42+L | 82 | 120 | 2 | 0.6 | 0.42 | 2.4 | 1.6 | 1.6 | 2.85 |
| HR 70 KBE 52X+L | 82 | 121 | 2 | 0.6 | 0.42 | 2.4 | 1.6 | 1.6 | 3.58 |
| HR 70 KBE 43+L | 88 | 142 | 2.5 | 1 | 0.35 | 2.9 | 2.0 | 1.9 | 6.45 |
| HR 75 KBE 42+L | 87 | 126 | 2 | 0.6 | 0.44 | 2.3 | 1.6 | 1.5 | 3.15 |
| HR 75 KBE 52X+L | 87 | 127 | 2 | 0.6 | 0.44 | 2.3 | 1.6 | 1.5 | 3.73 |
| HR 75 KBE 043+L | 93 | 151 | 2.5 | 1 | 0.35 | 2.9 | 2.0 | 1.9 | 7.66 |
| HR 80 KBE 042+L | 95 | 134 | 2 | 0.6 | 0.42 | 2.4 | 1.6 | 1.6 | 3.70 |
| HR 80 KBE 42+L | 95 | 134 | 2 | 0.6 | 0.42 | 2.4 | 1.6 | 1.6 | 3.70 |
| HR 80 KBE 52X+L | 95 | 136 | 2 | 0.6 | 0.42 | 2.4 | 1.6 | 1.6 | 4.59 |
| HR 80 KBE 043+L | 98 | 161 | 2.5 | 1 | 0.35 | 2.9 | 2.0 | 1.9 | 9.02 |
| HR 85 KBE 42+L | 100 | 143 | 2 | 0.6 | 0.42 | 2.4 | 1.6 | 1.6 | 4.69 |
| HR 85 KBE 52X+L | 100 | 144 | 2 | 0.6 | 0.42 | 2.4 | 1.6 | 1.6 | 5.70 |
| HR 85 KBE 043+L | 106 | 169 | 3 | 1 | 0.35 | 2.9 | 2.0 | 1.9 | 10.8 |
| HR 90 KBE 042+L | 105 | 152 | 2 | 0.6 | 0.42 | 2.4 | 1.6 | 1.6 | 5.53 |
| HR 90 KBE 42+L | 105 | 152 | 2 | 0.6 | 0.42 | 2.4 | 1.6 | 1.6 | 5.71 |
| HR 90 KBE 52X+L | 105 | 154 | 2 | 0.6 | 0.42 | 2.4 | 1.6 | 1.6 | 7.26 |

## Bore Diameter 90 – 120 mm




| Boundary Dimensions (mm) | | | | | | Basic Load Ratings (N) | | Limiting Speeds (min⁻¹) | |
|---|---|---|---|---|---|---|---|---|---|
| d | D | $B_2$ | C | r min. | $r_1$ min. | $C_r$ | $C_{0r}$ | Grease | Oil |
| **90** | 190 | 102 | 81 | 4 | 1 | 595 000 | 845 000 | 1 600 | 2 100 |
| | 190 | 144 | 115 | 4 | 1 | 770 000 | 1 180 000 | 1 600 | 2 200 |
| **95** | 170 | 78 | 63 | 3 | 1 | 385 000 | 570 000 | 1 700 | 2 300 |
| | 170 | 100 | 83 | 3 | 1 | 495 000 | 800 000 | 1 700 | 2 300 |
| | 200 | 108 | 85 | 4 | 1 | 640 000 | 910 000 | 1 500 | 2 000 |
| **100** | 165 | 52 | 46 | 2.5 | 0.6 | 222 000 | 340 000 | 1 700 | 2 300 |
| | 180 | 81 | 64 | 3 | 1 | 435 000 | 665 000 | 1 600 | 2 200 |
| | 180 | 81 | 65 | 3 | 1 | 435 000 | 665 000 | 1 600 | 2 200 |
| | 180 | 82 | 66 | 3 | 1 | 435 000 | 665 000 | 1 600 | 2 200 |
| | 180 | 83 | 67 | 3 | 1 | 435 000 | 665 000 | 1 600 | 2 200 |
| | 180 | 105 | 85 | 3 | 1 | 555 000 | 905 000 | 1 600 | 2 200 |
| | 180 | 107 | 87 | 3 | 1 | 555 000 | 905 000 | 1 600 | 2 200 |
| | 180 | 110 | 90 | 3 | 1 | 555 000 | 905 000 | 1 600 | 2 200 |
| | 215 | 112 | 87 | 4 | 1 | 725 000 | 1 050 000 | 1 400 | 1 900 |
| **105** | 190 | 88 | 70 | 3 | 1 | 480 000 | 735 000 | 1 500 | 2 000 |
| | 190 | 117 | 96 | 3 | 1 | 620 000 | 1 020 000 | 1 500 | 2 000 |
| | 190 | 115 | 95 | 3 | 1 | 620 000 | 1 020 000 | 1 500 | 2 000 |
| | 225 | 116 | 91 | 4 | 1 | 780 000 | 1 130 000 | 1 300 | 1 800 |
| **110** | 180 | 56 | 50 | 2.5 | 0.6 | 264 000 | 400 000 | 1 500 | 2 000 |
| | 180 | 70 | 56 | 2.5 | 0.6 | 340 000 | 555 000 | 1 500 | 2 000 |
| | 180 | 125 | 100 | 2.5 | 0.6 | 550 000 | 1 060 000 | 1 500 | 2 100 |
| | 200 | 90 | 72 | 3 | 1 | 540 000 | 840 000 | 1 400 | 1 900 |
| | 200 | 92 | 74 | 3 | 1 | 540 000 | 840 000 | 1 400 | 1 900 |
| | 200 | 120 | 100 | 3 | 1 | 685 000 | 1 130 000 | 1 400 | 1 900 |
| | 200 | 121 | 101 | 3 | 1 | 685 000 | 1 130 000 | 1 400 | 1 900 |
| | 240 | 118 | 93 | 4 | 1.5 | 830 000 | 1 190 000 | 1 200 | 1 700 |
| **120** | 180 | 46 | 41 | 2.5 | 0.6 | 184 000 | 296 000 | 1 500 | 2 000 |
| | 180 | 58 | 46 | 2.5 | 0.6 | 260 000 | 450 000 | 1 500 | 2 000 |
| | 200 | 62 | 55 | 2.5 | 0.6 | 310 000 | 500 000 | 1 400 | 1 800 |
| | 200 | 78 | 62 | 2.5 | 0.6 | 415 000 | 690 000 | 1 400 | 1 900 |
| | 200 | 100 | 84 | 2.5 | 0.6 | 515 000 | 885 000 | 1 400 | 1 800 |
| | 215 | 97 | 78 | 3 | 1 | 575 000 | 900 000 | 1 300 | 1 800 |
| | 215 | 132 | 109 | 3 | 1 | 750 000 | 1 270 000 | 1 300 | 1 800 |
| | 260 | 128 | 101 | 4 | 1 | 915 000 | 1 310 000 | 1 100 | 1 500 |
| | 260 | 188 | 145 | 4 | 1 | 1 320 000 | 2 110 000 | 1 100 | 1 500 |

**Remark** For other double-row tapered roller bearings not listed above, please contact NSK.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | $Y_3$ | 0.67 | $Y_2$ |

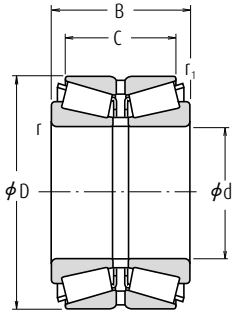
## Static Equivalent Load

$P_0=F_r+Y_0F_a$

The values of e, $Y_2$ , $Y_3$ and $Y_0$ are given in the table below.

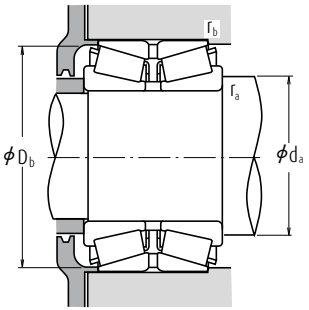
| Bearing Numbers | Abutment and Fillet Dimensions (mm) | | | | Constant | Axial Load Factors | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|
| | $d_a$ min. | $D_b$ min. | $r_a$ max. | $r_b$ max. | e | $Y_2$ | $Y_3$ | $Y_0$ | approx. |
| **HR 90 KBE 043+L** | 111 | 178 | 3 | 1 | 0.35 | 2.9 | 2.0 | 1.9 | 12.7 |
| **HR 90 KBE 1901+L** | 111 | 179 | 3 | 1 | 0.35 | 2.9 | 2.0 | 1.9 | 17.9 |
| **HR 95 KBE 42+L** | 113 | 161 | 2.5 | 1 | 0.42 | 2.4 | 1.6 | 1.6 | 6.75 |
| **HR 95 KBE 52+L** | 113 | 163 | 2.5 | 1 | 0.42 | 2.4 | 1.6 | 1.6 | 8.60 |
| **HR 95 KBE 43+L** | 116 | 187 | 3 | 1 | 0.35 | 2.9 | 2.0 | 1.9 | 14.7 |
| **100 KBE 31+L** | 115 | 156 | 2 | 0.6 | 0.33 | 3.0 | 2.0 | 2.0 | 4.04 |
| **HR100 KBE 1805+L** | 118 | 170 | 2.5 | 1 | 0.42 | 2.4 | 1.6 | 1.6 | 8.16 |
| **HR100 KBE 042+L** | 118 | 170 | 2.5 | 1 | 0.42 | 2.4 | 1.6 | 1.6 | 8.13 |
| **HR100 KBE 1801+L** | 118 | 170 | 2.5 | 1 | 0.42 | 2.4 | 1.6 | 1.6 | 8.22 |
| **HR100 KBE 42+L** | 118 | 170 | 2.5 | 1 | 0.42 | 2.4 | 1.6 | 1.6 | 8.7 |
| **HR100 KBE 1802+L** | 118 | 173 | 2.5 | 1 | 0.42 | 2.4 | 1.6 | 1.6 | 10.6 |
| **HR100 KBE 52X+L** | 118 | 173 | 2.5 | 1 | 0.42 | 2.4 | 1.6 | 1.6 | 10.7 |
| **HR100 KBE 1804+L** | 118 | 173 | 2.5 | 1 | 0.42 | 2.4 | 1.6 | 1.6 | 11 |
| **HR100 KBE 043+L** | 121 | 200 | 3 | 1 | 0.35 | 2.9 | 2.0 | 1.9 | 18.1 |
| **HR105 KBE 42X+L** | 123 | 179 | 2.5 | 1 | 0.42 | 2.4 | 1.6 | 1.6 | 9.76 |
| **HR105 KBE 1902+L** | 123 | 182 | 2.5 | 1 | 0.42 | 2.4 | 1.6 | 1.6 | 13.4 |
| **HR105 KBE 52+L** | 123 | 182 | 2.5 | 1 | 0.42 | 2.4 | 1.6 | 1.6 | 13.1 |
| **HR105 KBE 043+L** | 126 | 209 | 3 | 1 | 0.35 | 2.9 | 2.0 | 1.9 | 20.4 |
| **110 KBE 31+L** | 125 | 172 | 2 | 0.6 | 0.39 | 2.6 | 1.7 | 1.7 | 5.11 |
| **110 KBE 031+L** | 125 | 172 | 2 | 0.6 | 0.39 | 2.6 | 1.7 | 1.7 | 6.33 |
| **110 KBE 1802+L** | 125 | 172 | 2 | 0.6 | 0.26 | 3.8 | 2.6 | 2.5 | 11.4 |
| **HR110 KBE 42+L** | 128 | 190 | 2.5 | 1 | 0.42 | 2.4 | 1.6 | 1.6 | 11.2 |
| **HR110 KBE 42X+L** | 128 | 190 | 2.5 | 1 | 0.42 | 2.4 | 1.6 | 1.6 | 11.5 |
| **HR110 KBE 2001+L** | 128 | 193 | 2.5 | 1 | 0.42 | 2.4 | 1.6 | 1.6 | 15.4 |
| **HR110 KBE 52X+L** | 128 | 193 | 2.5 | 1 | 0.42 | 2.4 | 1.6 | 1.6 | 15.2 |
| **HR110 KBE 043+L** | 131 | 223 | 3 | 1.5 | 0.35 | 2.9 | 2.0 | 1.9 | 23.6 |
| **120 KBE 30+L** | 135 | 172 | 2 | 0.6 | 0.40 | 2.5 | 1.7 | 1.6 | 3.75 |
| **120 KBE 030+L** | 135 | 172 | 2 | 0.6 | 0.39 | 2.6 | 1.7 | 1.7 | 4.64 |
| **120 KBE 31+L** | 135 | 190 | 2 | 0.6 | 0.39 | 2.6 | 1.7 | 1.7 | 7.35 |
| **120 KBE 031+L** | 135 | 190 | 2 | 0.6 | 0.39 | 2.6 | 1.7 | 1.7 | 8.97 |
| **120 KBE 2001+L** | 135 | 193 | 2 | 0.6 | 0.37 | 2.7 | 1.8 | 1.8 | 11.3 |
| **HR120 KBE 42X+L** | 138 | 204 | 2.5 | 1 | 0.44 | 2.3 | 1.6 | 1.5 | 13.7 |
| **HR120 KBE 52X+L** | 138 | 207 | 2.5 | 1 | 0.44 | 2.3 | 1.6 | 1.5 | 18.8 |
| **HR120 KBE 43+L** | 141 | 240 | 3 | 1 | 0.35 | 2.9 | 2.0 | 1.9 | 29.4 |
| **HR120 KBE 2601+L** | 141 | 242 | 3 | 1 | 0.35 | 2.9 | 2.0 | 1.9 | 44.6 |

## Bore Diameter 125 – 150 mm




| Boundary Dimensions (mm) | | | | | | Basic Load Ratings (N) | | Limiting Speeds (min⁻¹) | |
|---|---|---|---|---|---|---|---|---|---|
| d | D | $B_2$ | C | r min. | $r_1$ min. | $C_r$ | $C_{0r}$ | Grease | Oil |
| **125** | 210 | 110 | 88 | 4 | 1 | 560 000 | 1 030 000 | 1 300 | 1 800 |
| **130** | 230 | 98 | 78.5 | 4 | 1 | 640 000 | 1 010 000 | 1 200 | 1 600 |
| | 230 | 100 | 80.5 | 4 | 1 | 640 000 | 1 010 000 | 1 200 | 1 600 |
| | 280 | 137 | 107.5 | 5 | 1.5 | 940 000 | 1 350 000 | 1 000 | 1 400 |
| | 230 | 145 | 115 | 4 | 1 | 905 000 | 1 580 000 | 1 200 | 1 700 |
| | 230 | 145 | 117.5 | 4 | 1 | 905 000 | 1 580 000 | 1 200 | 1 700 |
| | 230 | 150 | 120 | 4 | 1 | 905 000 | 1 580 000 | 1 200 | 1 700 |
| **140** | 210 | 53 | 47 | 2.5 | 0.6 | 280 000 | 495 000 | 1 200 | 1 700 |
| | 210 | 66 | 53 | 2.5 | 1 | 305 000 | 530 000 | 1 200 | 1 700 |
| | 210 | 106 | 94 | 2.5 | 0.6 | 555 000 | 1 200 000 | 1 300 | 1 700 |
| | 225 | 68 | 61 | 3 | 1 | 400 000 | 630 000 | 1 200 | 1 600 |
| | 225 | 84 | 68 | 3 | 1 | 490 000 | 850 000 | 1 200 | 1 600 |
| | 225 | 85 | 68 | 3 | 1 | 490 000 | 850 000 | 1 200 | 1 600 |
| | 230 | 120 | 94 | 3 | 1 | 685 000 | 1 270 000 | 1 200 | 1 600 |
| | 230 | 140 | 110 | 3 | 1 | 820 000 | 1 550 000 | 1 200 | 1 600 |
| | 240 | 132 | 106 | 4 | 1.5 | 685 000 | 1 360 000 | 1 100 | 1 500 |
| | 250 | 102 | 82.5 | 4 | 1 | 670 000 | 1 030 000 | 1 100 | 1 500 |
| | 250 | 153 | 125.5 | 4 | 1 | 1 040 000 | 1 830 000 | 1 100 | 1 500 |
| | 300 | 145 | 115.5 | 5 | 1.5 | 1 030 000 | 1 480 000 | 1 000 | 1 300 |
| **150** | 225 | 56 | 50 | 3 | 1 | 300 000 | 545 000 | 1 200 | 1 600 |
| | 225 | 70 | 56 | 3 | 1 | 395 000 | 685 000 | 1 200 | 1 600 |
| | 250 | 80 | 71 | 3 | 1 | 510 000 | 810 000 | 1 100 | 1 400 |
| | 250 | 100 | 80 | 3 | 1 | 630 000 | 1 090 000 | 1 100 | 1 400 |
| | 250 | 115 | 95 | 3 | 1 | 745 000 | 1 320 000 | 1 100 | 1 500 |
| | 260 | 150 | 115 | 4 | 1 | 815 000 | 1 520 000 | 1 100 | 1 400 |
| | 270 | 109 | 87 | 4 | 1 | 830 000 | 1 330 000 | 1 000 | 1 400 |
| | 270 | 164 | 130 | 4 | 1 | 1 210 000 | 2 150 000 | 1 000 | 1 400 |
| | 270 | 174 | 140 | 4 | 1 | 1 210 000 | 2 150 000 | 1 000 | 1 400 |
| | 320 | 154 | 120 | 5 | 1.5 | 1 420 000 | 2 130 000 | 900 | 1 200 |

**Remark** For other double-row tapered roller bearings not listed above, please contact NSK.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | $Y_3$ | 0.67 | $Y_2$ |

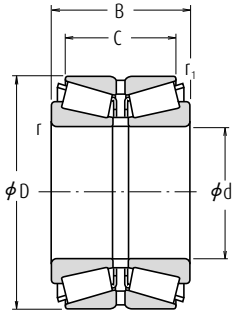
## Static Equivalent Load

$P_0=F_r+Y_0F_a$

The values of e, $Y_2$ , $Y_3$ and $Y_0$ are given in the table below.

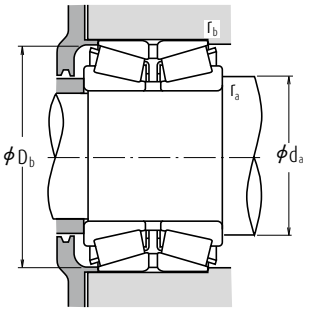
| Bearing Numbers | Abutment and Fillet Dimensions (mm) | | | | Constant | Axial Load Factors | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|
| | $d_a$ min. | $D_b$ min. | $r_a$ max. | $r_b$ max. | e | $Y_2$ | $Y_3$ | $Y_0$ | approx. |
| **125 KBE 2101+L** | 146 | 201 | 3 | 1 | 0.43 | 2.3 | 1.6 | 1.5 | 14.5 |
| **HR130 KBE 42+L** | 151 | 220 | 3 | 1 | 0.44 | 2.3 | 1.6 | 1.5 | 15.8 |
| **HR130 KBE 2301+L** | 151 | 220 | 3 | 1 | 0.44 | 2.3 | 1.6 | 1.5 | 15.9 |
| **130 KBE 43+L** | 157 | 258 | 4 | 1.5 | 0.36 | 2.8 | 1.9 | 1.8 | 35 |
| **HR130 KBE 2302+L** | 151 | 221 | 3 | 1 | 0.44 | 2.3 | 1.6 | 1.5 | 24.1 |
| **HR130 KBE 52+L** | 151 | 222 | 3 | 1 | 0.44 | 2.3 | 1.6 | 1.5 | 23.8 |
| **HR130 KBE 2303+L** | 151 | 221 | 3 | 1 | 0.44 | 2.3 | 1.6 | 1.5 | 24.2 |
| **140 KBE 30+L** | 155 | 202 | 2 | 0.6 | 0.39 | 2.6 | 1.7 | 1.7 | 6.02 |
| **140 KBE 030+L** | 155 | 202 | 2 | 1 | 0.40 | 2.5 | 1.7 | 1.6 | 7.02 |
| **140 KBE 2101+L** | 155 | 202 | 2 | 0.6 | 0.33 | 3.0 | 2.0 | 2.0 | 12.3 |
| **140 KBE 31+L** | 158 | 216 | 2.5 | 1 | 0.39 | 2.6 | 1.7 | 1.7 | 9.31 |
| **140 KBE 031+L** | 158 | 215 | 2.5 | 1 | 0.39 | 2.6 | 1.7 | 1.7 | 11.6 |
| **140 KBE 2201+L** | 158 | 215 | 2.5 | 1 | 0.39 | 2.6 | 1.7 | 1.7 | 11.7 |
| **140 KBE 2301+L** | 158 | 220 | 2.5 | 1 | 0.33 | 3.0 | 2.0 | 2.0 | 17.6 |
| **140 KBE 2302+L** | 158 | 221 | 2.5 | 1 | 0.35 | 2.9 | 2.0 | 1.9 | 20.7 |
| **140 KBE 2401+L** | 161 | 227 | 3 | 1.5 | 0.44 | 2.3 | 1.5 | 1.5 | 22.7 |
| **HR140 KBE 42+L** | 161 | 237 | 3 | 1 | 0.44 | 2.3 | 1.6 | 1.5 | 18.9 |
| **HR140 KBE 52X+L** | 161 | 241 | 3 | 1 | 0.44 | 2.3 | 1.6 | 1.5 | 29.6 |
| **140 KBE 43+L** | 167 | 275 | 4 | 1.5 | 0.36 | 2.8 | 1.9 | 1.8 | 42.6 |
| **150 KBE 30+L** | 168 | 213 | 2.5 | 1 | 0.35 | 2.9 | 2.0 | 1.9 | 7.41 |
| **150 KBE 030+L** | 168 | 215 | 2.5 | 1 | 0.35 | 2.9 | 2.0 | 1.9 | 8.70 |
| **150 KBE 31+L** | 168 | 240 | 2.5 | 1 | 0.40 | 2.5 | 1.7 | 1.6 | 14.2 |
| **150 KBE 031+L** | 168 | 238 | 2.5 | 1 | 0.39 | 2.6 | 1.7 | 1.7 | 17.8 |
| **150 KBE 2502+L** | 168 | 238 | 2.5 | 1 | 0.37 | 2.7 | 1.8 | 1.8 | 20.9 |
| **150 KBE 2601+L** | 171 | 242 | 3 | 1 | 0.43 | 2.3 | 1.6 | 1.5 | 30.0 |
| **HR150 KBE 42+L** | 171 | 253 | 3 | 1 | 0.44 | 2.3 | 1.6 | 1.5 | 24.3 |
| **HR150 KBE 52X+L** | 171 | 257 | 3 | 1 | 0.44 | 2.3 | 1.6 | 1.5 | 37.3 |
| **HR150 KBE 2701+L** | 171 | 257 | 3 | 1 | 0.44 | 2.3 | 1.6 | 1.5 | 39.7 |
| **HR150 KBE 43+L** | 177 | 295 | 4 | 1.5 | 0.35 | 2.9 | 2.0 | 1.9 | 53.4 |

## Bore Diameter 160 – 200 mm




| Boundary Dimensions (mm) | | | | | | Basic Load Ratings (N) | | Limiting Speeds (min⁻¹) | |
|---|---|---|---|---|---|---|---|---|---|
| d | D | $B_2$ | C | r min. | $r_1$ min. | $C_r$ | $C_{0r}$ | Grease | Oil |
| **160** | 240 | 60 | 53 | 3 | 1 | 355 000 | 580 000 | 1 100 | 1 500 |
| | 240 | 75 | 60 | 3 | 1 | 395 000 | 710 000 | 1 100 | 1 500 |
| | 240 | 110 | 90 | 3 | 1 | 650 000 | 1 290 000 | 1 100 | 1 500 |
| | 270 | 86 | 76 | 3 | 1 | 540 000 | 885 000 | 1 000 | 1 300 |
| | 270 | 108 | 86 | 3 | 1 | 775 000 | 1 380 000 | 1 000 | 1 300 |
| | 270 | 140 | 120 | 3 | 1 | 990 000 | 1 880 000 | 1 000 | 1 300 |
| | 280 | 150 | 125 | 4 | 1 | 1 100 000 | 2 020 000 | 1 000 | 1 300 |
| | 290 | 115 | 91 | 4 | 1 | 800 000 | 1 220 000 | 900 | 1 300 |
| | 290 | 178 | 144 | 4 | 1 | 1 360 000 | 2 440 000 | 1 000 | 1 300 |
| | 340 | 160 | 126 | 5 | 1.5 | 1 310 000 | 1 920 000 | 800 | 1 100 |
| **165** | 290 | 150 | 125 | 4 | 1 | 1 140 000 | 2 130 000 | 900 | 1 300 |
| **170** | 250 | 85 | 65 | 3 | 1 | 435 000 | 845 000 | 1 000 | 1 400 |
| | 260 | 67 | 60 | 3 | 1 | 400 000 | 700 000 | 1 000 | 1 300 |
| | 260 | 84 | 67 | 3 | 1 | 575 000 | 1 030 000 | 1 000 | 1 300 |
| | 280 | 88 | 78 | 3 | 1 | 630 000 | 1 040 000 | 900 | 1 300 |
| | 280 | 110 | 88 | 3 | 1 | 820 000 | 1 450 000 | 900 | 1 300 |
| | 280 | 150 | 130 | 3 | 1 | 1 110 000 | 2 160 000 | 1 000 | 1 300 |
| | 310 | 192 | 152 | 5 | 1.5 | 1 590 000 | 2 910 000 | 900 | 1 200 |
| **180** | 280 | 74 | 66 | 3 | 1 | 455 000 | 810 000 | 900 | 1 300 |
| | 280 | 93 | 74 | 3 | 1 | 655 000 | 1 220 000 | 900 | 1 200 |
| | 300 | 96 | 85 | 4 | 1.5 | 725 000 | 1 210 000 | 900 | 1 200 |
| | 300 | 120 | 96 | 4 | 1.5 | 940 000 | 1 690 000 | 900 | 1 200 |
| | 320 | 127 | 99 | 5 | 1.5 | 895 000 | 1 390 000 | 800 | 1 200 |
| | 320 | 192 | 152 | 5 | 1.5 | 1 640 000 | 3 050 000 | 900 | 1 200 |
| | 340 | 180 | 140 | 5 | 1.5 | 1 410 000 | 2 510 000 | 800 | 1 100 |
| **190** | 290 | 75 | 67 | 3 | 1 | 490 000 | 845 000 | 900 | 1 200 |
| | 290 | 94 | 75 | 3 | 1 | 670 000 | 1 230 000 | 900 | 1 200 |
| | 320 | 104 | 92 | 4 | 1.5 | 800 000 | 1 380 000 | 800 | 1 100 |
| | 320 | 130 | 104 | 4 | 1.5 | 1 070 000 | 1 960 000 | 800 | 1 100 |
| | 340 | 133 | 105 | 5 | 1.5 | 990 000 | 1 580 000 | 800 | 1 100 |
| | 340 | 204 | 160 | 5 | 1.5 | 1 910 000 | 3 550 000 | 800 | 1 100 |
| **200** | 310 | 152 | 123 | 3 | 1 | 1 300 000 | 2 740 000 | 800 | 1 100 |
| | 320 | 146 | 110 | 5 | 1.5 | 990 000 | 2 120 000 | 800 | 1 100 |
| | 330 | 180 | 140 | 5 | 1.5 | 1 390 000 | 2 730 000 | 800 | 1 100 |
| | 340 | 112 | 100 | 4 | 1.5 | 940 000 | 1 670 000 | 800 | 1 000 |
| | 340 | 140 | 112 | 4 | 1.5 | 1 260 000 | 2 250 000 | 800 | 1 000 |
| | 360 | 142 | 110 | 5 | 1.5 | 1 100 000 | 1 780 000 | 700 | 1 000 |
| | 360 | 218 | 174 | 5 | 1.5 | 2 070 000 | 3 850 000 | 800 | 1 000 |

**Remark** For other double-row tapered roller bearings not listed above, please contact NSK.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | $Y_3$ | 0.67 | $Y_2$ |

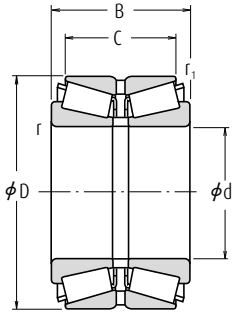
## Static Equivalent Load

$P_0=F_r+Y_0F_a$

The values of e, $Y_2$ , $Y_3$ and $Y_0$ are given in the table below.

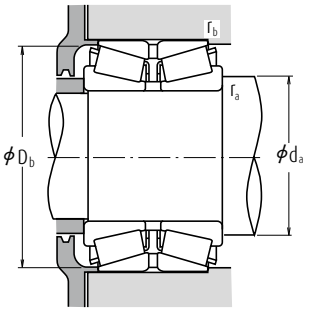
| Bearing Numbers | Abutment and Fillet Dimensions (mm) | | | | Constant | Axial Load Factors | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|
| | $d_a$ min. | $D_b$ min. | $r_a$ max. | $r_b$ max. | e | $Y_2$ | $Y_3$ | $Y_0$ | approx. |
| **160 KBE 30+L** | 178 | 231 | 2.5 | 1 | 0.37 | 2.7 | 1.8 | 1.8 | 8.56 |
| **160 KBE 030+L** | 178 | 230 | 2.5 | 1 | 0.40 | 2.5 | 1.7 | 1.6 | 10.5 |
| **160 KBE 2401+L** | 178 | 232 | 2.5 | 1 | 0.38 | 2.6 | 1.8 | 1.7 | 16.2 |
| **160 KBE 31+L** | 178 | 255 | 2.5 | 1 | 0.40 | 2.5 | 1.7 | 1.6 | 18.6 |
| **160 KBE 031+L** | 178 | 256 | 2.5 | 1 | 0.39 | 2.6 | 1.7 | 1.7 | 23.1 |
| **160 KBE 2701+L** | 178 | 261 | 2.5 | 1 | 0.39 | 2.6 | 1.7 | 1.7 | 30.6 |
| **160 KBE 2801+L** | 181 | 266 | 3 | 1 | 0.32 | 3.2 | 2.1 | 2.1 | 35.9 |
| **160 KBE 42+L** | 181 | 275 | 3 | 1 | 0.43 | 2.3 | 1.6 | 1.5 | 28.2 |
| **HR160 KBE 52X+L** | 181 | 277 | 3 | 1 | 0.44 | 2.3 | 1.6 | 1.5 | 47.3 |
| **160 KBE 43+L** | 187 | 314 | 4 | 1.5 | 0.36 | 2.8 | 1.9 | 1.8 | 60.4 |
| **165 KBE 2901+L** | 186 | 272 | 3 | 1 | 0.33 | 3.1 | 2.1 | 2.0 | 39.5 |
| **170 KBE 2501+L** | 188 | 241 | 2.5 | 1 | 0.44 | 2.3 | 1.5 | 1.5 | 12.3 |
| **170 KBE 30+L** | 188 | 248 | 2.5 | 1 | 0.40 | 2.5 | 1.7 | 1.6 | 11.8 |
| **170 KBE 030+L** | 188 | 249 | 2.5 | 1 | 0.39 | 2.6 | 1.7 | 1.7 | 14.4 |
| **170 KBE 31+L** | 188 | 266 | 2.5 | 1 | 0.39 | 2.6 | 1.7 | 1.7 | 19.7 |
| **170 KBE 031+L** | 188 | 268 | 2.5 | 1 | 0.39 | 2.6 | 1.7 | 1.7 | 24.2 |
| **170 KBE 2802+L** | 188 | 269 | 2.5 | 1 | 0.39 | 2.6 | 1.7 | 1.7 | 34.6 |
| **HR170 KBE 52X+L** | 197 | 297 | 4 | 1.5 | 0.44 | 2.3 | 1.6 | 1.5 | 57.3 |
| **180 KBE 30+L** | 198 | 265 | 2.5 | 1 | 0.40 | 2.5 | 1.7 | 1.6 | 15.4 |
| **180 KBE 030+L** | 198 | 265 | 2.5 | 1 | 0.35 | 2.9 | 2.0 | 1.9 | 14.4 |
| **180 KBE 31+L** | 201 | 284 | 3 | 1.5 | 0.39 | 2.6 | 1.7 | 1.7 | 24.8 |
| **180 KBE 031+L** | 201 | 287 | 3 | 1.5 | 0.39 | 2.6 | 1.7 | 1.7 | 31.1 |
| **180 KBE 42+L** | 207 | 300 | 4 | 1.5 | 0.44 | 2.3 | 1.5 | 1.5 | 36.5 |
| **HR180 KBE 52X+L** | 207 | 308 | 4 | 1.5 | 0.45 | 2.2 | 1.5 | 1.5 | 59.2 |
| **180 KBE 3401+L** | 207 | 305 | 4 | 1.5 | 0.43 | 2.3 | 1.6 | 1.5 | 68.1 |
| **190 KBE 30+L** | 208 | 279 | 2.5 | 1 | 0.39 | 2.6 | 1.7 | 1.7 | 16.2 |
| **190 KBE 030+L** | 208 | 279 | 2.5 | 1 | 0.40 | 2.5 | 1.7 | 1.6 | 20.1 |
| **190 KBE 31+L** | 211 | 301 | 3 | 1.5 | 0.40 | 2.5 | 1.7 | 1.6 | 30.9 |
| **190 KBE 031+L** | 211 | 302 | 3 | 1.5 | 0.39 | 2.6 | 1.7 | 1.7 | 39.0 |
| **190 KBE 42+L** | 217 | 320 | 4 | 1.5 | 0.40 | 2.5 | 1.7 | 1.6 | 43.9 |
| **HR190 KBE 52X+L** | 217 | 327 | 4 | 1.5 | 0.44 | 2.3 | 1.6 | 1.5 | 70.8 |
| **HR200 KBE 3101+L** | 218 | 301 | 2.5 | 1 | 0.43 | 2.3 | 1.6 | 1.5 | 40.1 |
| **200 KBE 3201+L** | 227 | 301 | 4 | 1.5 | 0.52 | 1.9 | 1.3 | 1.3 | 41.6 |
| **200 KBE 3301+L** | 227 | 316 | 4 | 1.5 | 0.42 | 2.4 | 1.6 | 1.6 | 54.4 |
| **200 KBE 31+L** | 221 | 321 | 3 | 1.5 | 0.40 | 2.5 | 1.7 | 1.6 | 38.8 |
| **200 KBE 031+L** | 221 | 324 | 3 | 1.5 | 0.39 | 2.6 | 1.7 | 1.7 | 47.0 |
| **200 KBE 42+L** | 227 | 338 | 4 | 1.5 | 0.40 | 2.5 | 1.7 | 1.6 | 52.6 |
| **HR200 KBE 52+L** | 227 | 344 | 4 | 1.5 | 0.41 | 2.5 | 1.7 | 1.6 | 88.3 |

## Bore Diameter 206 – 260 mm




| Boundary Dimensions (mm) | | | | | | Basic Load Ratings (N) | | Limiting Speeds ($min^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|
| d | D | $B_2$ | C | r min. | $r_1$ min. | $C_r$ | $C_{0r}$ | Grease | Oil |
| **206** | 283 | 102 | 83 | 4 | 1.5 | 580 000 | 1 430 000 | 900 | 1 200 |
| **210** | 355 | 116 | 103 | 4 | 1.5 | 905 000 | 1 520 000 | 700 | 1 000 |
| **220** | 300 | 110 | 88 | 3 | 1 | 730 000 | 1 710 000 | 800 | 1 100 |
| | 340 | 90 | 80 | 4 | 1.5 | 695 000 | 1 280 000 | 700 | 1 000 |
| | 340 | 113 | 90 | 4 | 1.5 | 920 000 | 1 830 000 | 700 | 1 000 |
| | 370 | 120 | 107 | 5 | 1.5 | 1 110 000 | 1 940 000 | 700 | 1 000 |
| | 370 | 150 | 120 | 5 | 1.5 | 1 460 000 | 2 760 000 | 700 | 1 000 |
| | 400 | 158 | 122 | 5 | 1.5 | 1 390 000 | 2 300 000 | 600 | 900 |
| **240** | 360 | 92 | 82 | 4 | 1.5 | 780 000 | 1 490 000 | 700 | 900 |
| | 360 | 115 | 92 | 4 | 1.5 | 1 020 000 | 2 040 000 | 700 | 900 |
| | 400 | 128 | 114 | 5 | 1.5 | 1 180 000 | 2 190 000 | 600 | 900 |
| | 400 | 160 | 128 | 5 | 1.5 | 1 620 000 | 3 050 000 | 600 | 900 |
| | 400 | 209 | 168 | 5 | 1.5 | 2 220 000 | 4 450 000 | 600 | 900 |
| **250** | 380 | 98 | 87 | 4 | 1 | 795 000 | 1 460 000 | 600 | 900 |
| **260** | 400 | 104 | 92 | 5 | 1.5 | 895 000 | 1 670 000 | 600 | 800 |
| | 400 | 130 | 104 | 5 | 1.5 | 1 210 000 | 2 460 000 | 600 | 800 |
| | 440 | 144 | 128 | 5 | 1.5 | 1 540 000 | 2 760 000 | 600 | 800 |
| | 440 | 172 | 145 | 5 | 1.5 | 1 870 000 | 3 500 000 | 600 | 800 |
| | 440 | 180 | 144 | 5 | 1.5 | 2 110 000 | 4 150 000 | 600 | 800 |

**Remark** For other double-row tapered roller bearings not listed above, please contact NSK.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | $Y_3$ | 0.67 | $Y_2$ |

## Static Equivalent Load

$P_0=F_r+Y_0F_a$

The values of e, $Y_2$ , $Y_3$ and $Y_0$ are given in the table below.

| Bearing Numbers | Abutment and Fillet Dimensions (mm) | | | | Constant | Axial Load Factors | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|
| | $d_a$ min. | $D_b$ min. | $r_a$ max. | $r_b$ max. | e | $Y_2$ | $Y_3$ | $Y_0$ | approx. |
| **206 KBE 2801+L** | 227 | 275 | 3 | 1.5 | 0.51 | 2.0 | 1.3 | 1.3 | 18.1 |
| **210 KBE 31+L** | 231 | 338 | 3 | 1.5 | 0.46 | 2.2 | 1.5 | 1.4 | 41.7 |
| **220 KBE 3001+L** | 238 | 292 | 2.5 | 1 | 0.37 | 2.7 | 1.8 | 1.8 | 21.2 |
| **220 KBE 30+L** | 241 | 324 | 3 | 1.5 | 0.40 | 2.5 | 1.7 | 1.6 | 27.9 |
| **220 KBE 030+L** | 241 | 327 | 3 | 1.5 | 0.40 | 2.5 | 1.7 | 1.6 | 34.7 |
| **220 KBE 31+L** | 247 | 345 | 4 | 1.5 | 0.39 | 2.6 | 1.7 | 1.7 | 48.3 |
| **220 KBE 031+L** | 247 | 349 | 4 | 1.5 | 0.39 | 2.6 | 1.7 | 1.7 | 60.2 |
| **220 KBE 42+L** | 247 | 371 | 4 | 1.5 | 0.40 | 2.5 | 1.7 | 1.6 | 74.2 |
| **240 KBE 30+L** | 261 | 344 | 3 | 1.5 | 0.39 | 2.6 | 1.7 | 1.7 | 30.1 |
| **240 KBE 030+L** | 261 | 344 | 3 | 1.5 | 0.35 | 2.9 | 2.0 | 1.9 | 37.3 |
| **240 KBE 31+L** | 267 | 380 | 4 | 1.5 | 0.43 | 2.3 | 1.6 | 1.5 | 60.0 |
| **240 KBE 031+L** | 267 | 378 | 4 | 1.5 | 0.39 | 2.6 | 1.7 | 1.7 | 73.6 |
| **240 KBE 4003+L** | 267 | 384 | 4 | 1.5 | 0.33 | 3.0 | 2.0 | 2.0 | 96.4 |
| **250 KBE 3801+L** | 271 | 365 | 3 | 1 | 0.40 | 2.5 | 1.7 | 1.6 | 35.5 |
| **260 KBE 30+L** | 287 | 379 | 4 | 1.5 | 0.40 | 2.5 | 1.7 | 1.6 | 43.4 |
| **260 KBE 030+L** | 287 | 382 | 4 | 1.5 | 0.40 | 2.5 | 1.7 | 1.6 | 54.1 |
| **260 KBE 31+L** | 287 | 416 | 4 | 1.5 | 0.39 | 2.6 | 1.7 | 1.7 | 82.5 |
| **260 KBE 4401+L** | 287 | 414 | 4 | 1.5 | 0.38 | 2.6 | 1.8 | 1.7 | 98.1 |
| **260 KBE 031+L** | 287 | 416 | 4 | 1.5 | 0.39 | 2.6 | 1.7 | 1.7 | 104.0 |



## 7. SPHERICAL ROLLER BEARINGS

Introduction ..... B 276

## TECHNICAL DATA

Free Space of Spherical Roller Bearings ..... B 278
Measuring Bearing Clearance ..... B 280

## TECHNICAL DATA

## SPHERICAL ROLLER BEARINGS

Cylindrical Bores, Tapered Bores — Bore Diameter 20 – 1400 mm ..... B 284

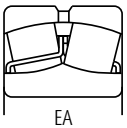
## DESIGNS, TYPES AND FEATURES

High load capacity designs EA, C, CD and CA, shown in the figures are available. Types EA, C and CD have pressed steel cages, and type CA has machined brass cage. The EA type bearings listed here are classified as NSKHPS bearings, which offer particularly high load-carrying capacity, high limiting speeds and are highly functional under high-temperature operating conditions of up to 200°C.

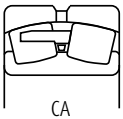
An oil groove and holes are provided in the outer ring to supply lubricant and the bearing numbers are suffixed with E4.

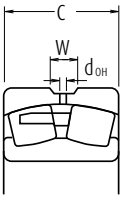
To use bearings with oil grooves and holes, it is recommended to provide an oil groove in the housing bore, since the depth of the groove in the bearing is limited. The number and dimensions of the oil groove and holes are shown in Tables 1 and 2.

If bearings with a hole for a locking pin to prevent outer ring rotation are required, please inform NSK.


EA


C and CD


CA




### Table 1 Dimensions of Oil Grooves and Holes

Units : mm

| Nominal Outer Ring Width C | | Oil Groove Width W | Hole Diameter $d_{OH}$ |
|---|---|---|---|
| over | incl. | | |
| 18 | 30 | 5 | 2.5 |
| 30 | 40 | 6 | 3 |
| 40 | 50 | 7 | 4 |
| 50 | 65 | 8 | 5 |
| 65 | 80 | 10 | 6 |
| 80 | 100 | 12 | 8 |
| 100 | 120 | 15 | 10 |
| 120 | 160 | 20 | 12 |
| 160 | 200 | 25 | 15 |
| 200 | 250 | 30 | 20 |
| 250 | 315 | 35 | 20 |
| 315 | 400 | 40 | 25 |
| 400 | — | 40 | 25 |

### Table 2 Number of Oil Holes

| Nominal Outer Ring Diameter D (mm) | | Number of Holes |
|---|---|---|
| over | incl. | |
| — | 180 | 4 |
| 180 | 250 | 6 |
| 250 | 315 | 6 |
| 315 | 400 | 6 |
| 400 | 500 | 6 |
| 500 | 630 | 8 |
| 630 | 800 | 8 |
| 800 | 1000 | 8 |
| 1000 | 1250 | 8 |
| 1250 | 1600 | 8 |
| 1600 | 2000 | 8 |

| | Table | Pages |
|---|---|---|
| Tolerance and Running Accuracy | 7.2 | A 128 to A 131 |
| Recommended Fits | 8.3 | A 164 |
| | 8.5 | A 165 |
| Internal Clearance | 8.16 | A 172 |

## PERMISSIBLE MISALIGNMENT

The permissible misalignment of spherical roller bearings varies depending on the size and load, but it is approximately 0.018 to 0.045 radian (1° to 2.5°) with normal loads.

## LIMITING SPEEDS (GREASE)

The limiting speeds (grease) listed in the bearing tables should be adjusted depending on the bearing load conditions. Also, higher speeds are attainable by making changes in the lubrication method, cage design, etc. Refer to Page A098 for detailed information.

## PRECAUTIONS FOR USE OF SPHERICAL ROLLER BEARINGS

If the load on spherical roller bearings becomes too small during operation or if the ratio of axial and radial loads is larger than the value of 'e'(listed in the bearing tables), slippage occurs between the rollers and raceways, which may result in smearing. The higher the weight of the rollers and cage, the higher this tendency becomes, especially for large spherical roller bearings.

If very small bearing loads are expected, please contact NSK for selection of an appropriate bearing.



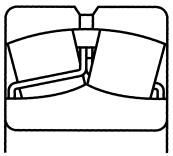
## TECHNICAL DATA

### Free Space of Spherical Roller Bearings

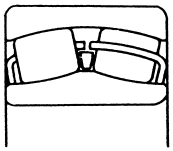
The spherical roller bearing has self-aligning ability and capacity to carry substantially large radial and bi-axial loads. For these reasons, this bearing is used widely in many applications. Application problems include a long span, which causes substantial deflection of the shaft, as well as installation errors and axial misalignment. These bearings may be exposed to a large radial or shock loads.

Grease lubrication is common for spherical roller bearings because it simplifies the seal construction around the housing and makes maintenance and inspection easier. In this case, it is important to select a grease appropriate to the operating conditions and to fill the bearing with the proper amount of grease considering the housing internal space.

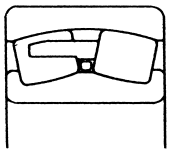
As a reference, the bearing free space for conventional types plus four other types (EA, C, CD, and CA) is shown in Table 1. Under general operating conditions, it is appropriate to pack a large quantity of grease into the bearing internal space and to pack grease into the housing internal space other than the bearing itself, to the extent of 1/3 to 2/3 that of the free space.



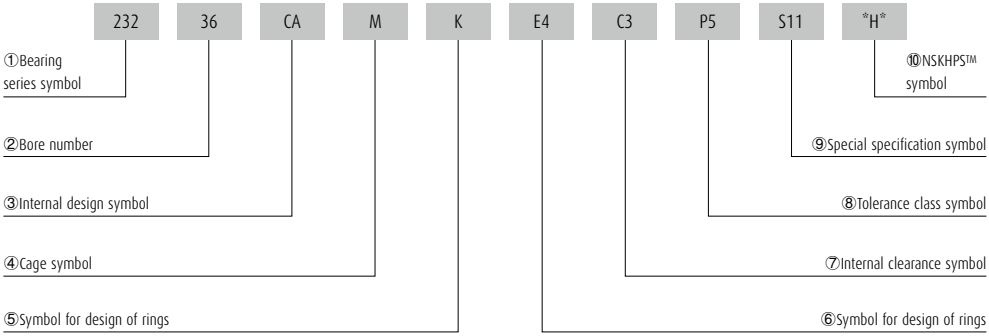
EA type



C, CD type



CA type




| | |
|---|---|
| ①Bearing series symbol | 239, 230, 240, 231, 241, 222, 232, 213, 223: Spherical Roller Bearings |
| ②Bore number | Bore number indicates bore diameter. Bore number ×5 (mm) |
| ③Internal design symbol | EA, CA: High Load Capacity |
| ④Cage symbol | M : Machined Brass Cage (for CA Design)<br>Omitted: Pressed Steel Cage (for EA Design) |
| ⑤⑥Symbol for design of rings | K: Tapered Bore of Inner Ring (Taper 1:12)<br>K30: Tapered Bore of Inner Ring (Taper 1:30)<br>E4: Lubricating groove in outside surface and Holes in outer ring |
| ⑦Internal clearance symbol | Omitted: CN clearance, C3: Clearance greater than CN,<br>C4: Clearance greater than C3, C5: Clearance greater than C4 |
| ⑧Tolerance class symbol | Omitted: ISO Normal, P6: ISO Class 6, P5: ISO Class 5, P4: ISO Class 4 |
| ⑨Special specification symbol | S11; Dimensional Stabiliging Treatment Working Temperature Lower than 200°C<br>(Omitted for EA Design) |
| ⑩NSKHPS™ | *H*: NSKHPS™ Symbol<br>Tolerance Class: ISO Normal |

## Table 1 Free Space of Spherical Roller Bearing (EA, C, CD, and CA)

Units : $cm^3$

| Bearing Bore No. | Bearing Free Space | | | | |
|---|---|---|---|---|---|
| | Bearing Series | | | | |
| | 230 | 231 | 222 | 232 | 223 |
| 11 | — | — | 29 | — | 78 |
| 12 | — | — | 42 | — | 96 |
| 13 | — | — | 48 | — | 113 |
| 14 | — | — | 52 | — | 139 |
| 15 | — | — | 57 | — | 170 |
| 16 | — | — | 71 | — | 206 |
| 17 | — | — | 91 | — | 234 |
| 18 | — | — | 110 | 130 | 283 |
| 19 | — | — | 135 | — | 327 |
| 20 | — | — | 169 | 203 | 410 |
| 22 | 100 | 150 | 242 | 294 | 560 |
| 24 | 109 | 228 | 297 | 340 | 700 |
| 26 | 161 | 240 | 365 | 405 | 955 |
| 28 | 170 | 292 | 400 | 530 | 1 230 |
| 30 | 209 | 465 | 505 | 680 | 1 430 |
| 32 | 254 | 575 | 680 | 850 | 1 710 |
| 34 | 355 | 610 | 785 | 1 090 | 2 070 |
| 36 | 465 | 785 | 810 | 1 120 | 2 460 |
| 38 | 565 | 970 | 1 160 | 1 340 | 2 830 |
| 40 | 715 | 1 160 | 1 400 | 1 640 | 2 900 |
| 44 | 940 | 1 500 | 1 880 | 2 270 | 3 750 |
| 48 | 1 030 | 1 900 | 2 550 | 3 550 | 4 700 |
| 52 | 1 530 | 2 940 | 3 300 | 4 750 | 5 900 |
| 56 | 1 820 | 3 150 | 3 400 | 4 950 | 7 250 |
| 60 | 2 200 | 4 050 | 4 300 | 6 200 | 8 750 |

**Remarks** 22211 to 22226, 22311 to 22324 are EA Type Bearings.
23122 to 23148, 23218 to 23244 are C Type Bearings.
23022 to 23036, 22228 to 22236 are CD Type Bearings.
23038 to 23060, 23152 to 23160, 22238 to 22260,
23248 to 23260, and 22326 to 22360 are CA Type Bearing.

## Measurement of Bearing Clearance

For the bearing mounting, the measurement of internal bearing clearance is a most important task. Before handling the bearing and measuring the internal bearing clearance, be sure to wear thin rubber gloves. (If a bearing is touched by a bare hand, the touched part may rust.) When measuring the internal bearing clearance, pay careful attention so that the rollers are positioned correctly.

### 1. Measurement of Bearing Clearance

To measure only internal bearing clearance, set the bearing standing upright (vertically) on a flat surface, while holding its outer ring with one hand. While paying attention not to incline the inner and outer rings, stabilize the rollers by turning the inner ring to the right and left by about one half to one full rotation. Adjust rollers until one randomly chosen roller of the double rows is positioned to be exactly at the top. Now, the internal clearance is measured with a thickness gauge. The measurement position and measured point vary slightly depending on the size of the outer ring outside diameter.

### 1.1 Bearing Outside Diameter Is Smaller Than 200 mm

Insert the thickness gauge between rollers of 2 rows which have a roller positioned exactly at the top of the bearing and outer ring. Now, measure the internal clearance ($\Delta_r$). (Fig. 1)

### 1.2 Bearing Outside Diameter Is Larger Than 200 mm

Insert the thickness gauge between the rollers of the 2 rows, which each have been positioned to be exactly at the top, and outer ring and between 2 rows of bearing at symmetrical position relative to the bearing center, then measure the respective internal clearance of the bearing. (Fig. 2). For the internal bearing clearance ($\Delta_r$), take that value measured between 2 rows of just top of bearing and outer ring as respectively $\Delta_{rT1}$ and $\Delta_{rT2}$ and that value measured just at top of the bearing as $\Delta_{rT}$.

$$\Delta_{rT} = 1/2\ (\Delta_{rT1} + \Delta_{rT2})$$

Among internal clearances between 2 rows of rollers that are symmetrical relative to the bearing center and outer ring, take that measurement between 2 rows of rollers of left side respectively as $\Delta_{rL1}$ and $\Delta_{rL2}$. The internal clearance on the left side of the bearing is $\Delta_{rL}$:

$$\Delta_{rL} = 1/2\ (\Delta_{rL1} + \Delta_{rL2})$$

Take that measurement between 2 rows of rollers of right side respectively as $\Delta_{rR1}$ and $\Delta_{rR2}$. The internal clearance of the right side of the bearing is $\Delta_{rR}$:

$$\Delta_{rR} = 1/2\ (\Delta_{rR1} + \Delta_{rR2})$$

The internal bearing clearance ($\Delta_r$) is given by the following equation:

$$\Delta_r = 1/2\ (\Delta_{rT} + \Delta_{rL} + \Delta_{rR})$$

### 2. Measuring Bearing Clearance When Mounted on Shaft or Sleeve

Basically, the measurement of the clearance istaken when the outer ring of bearing hangs down from rollers. At first, while holding the bearing up-right, rotate the outer ring in the clockwise and counter-clockwise directions by one half to one full rotation until both rows have a randomly chosen roller positioned exactly at the bottom. The clearance is measured with a thickness gauge butdiameter.

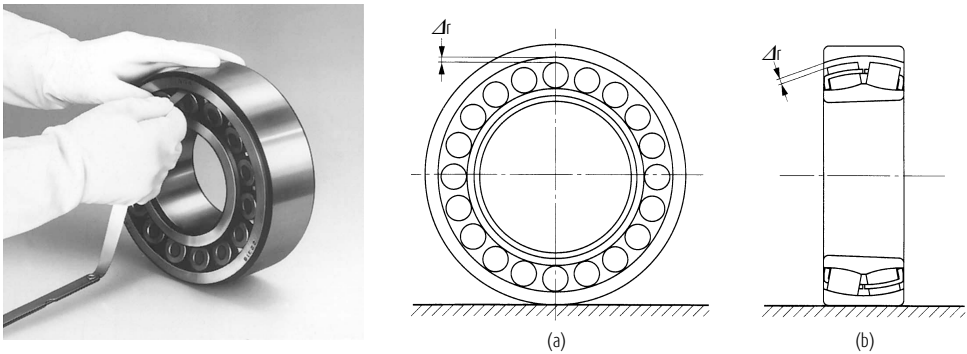



Fig. 1 Clearance Measurement Point (Bearing Outside Diameter: Less Than 200 mm)

the measurement point varies slightly depending on the size of the outer ring outside diameter.

### 2.1 Bearing Outside Diameter Is Smaller Than 200 mm

Insert the thickness gauge between rollers of 2 rows of just at the bottom of the bearing and outer ring and measure the internal clearance ($\Delta_{rS}$).(Fig. 3)

### 2.2 Bearing Outside Diameter Is Larger Than 200 mm

Insert the thickness gauge between rollers of 2 rows that are positioned just at the bottom of bearing and outer ring and between 2 rows of bearing rollers symmetrical relative to the bearing center, then, measure the respective internal clearance of the bearing. (Fig. 3) For the internal bearing clearance ($\Delta_r$), take the measurement when the roller is positioned exactly at the bottom, since the bearing has 2 rows, two values must be measured. The bearing internal clearance is $\Delta_{rS1}$ and $\Delta_{rS2}$ while that value measured at the exact bottom of the bearing is $\Delta_{rS}$.

$$\Delta_{rS} = 1/2\ (\Delta_{rS1} + \Delta_{rS2})$$

Among internal clearances between 2 rows of rollers symmetrical relative to the bearing center and outer ring, take that value measured between 2 rows of rollers of left side respectively as $\Delta_{rL1}$ and $\Delta_{rL2}$ and the internal clearance of left side of bearing as $\Delta_{rL}$.

$$\Delta_{rL} = 1/2\ (\Delta_{rL1} + \Delta_{rL2})$$

The internal clearances measured between 2 rows of rollers on the right side respectively as $\Delta_{rR1}$ and $\Delta_{rR2}$. The internal clearance of right side of bearing is $\Delta_{rR}$.

$$\Delta_{rR} = 1/2\ (\Delta_{rR1} + \Delta_{rR2})$$

The internal bearing clearance ($\Delta_r$) is given by the following equation:

$$\Delta_r = 1/2\ (\Delta_{rS} + \Delta_{rL} + \Delta_{rR})$$

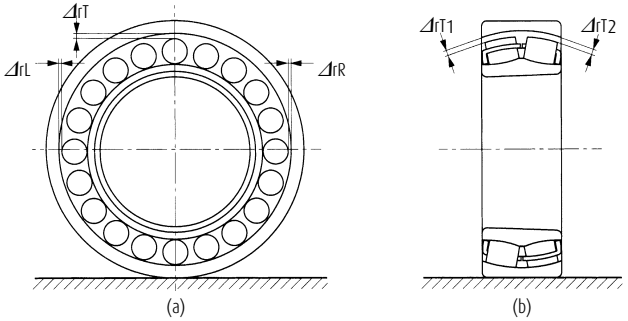



Fig. 2 Clearance Measurement Point (Bearing Outside Diameter: Larger Than 200 mm)

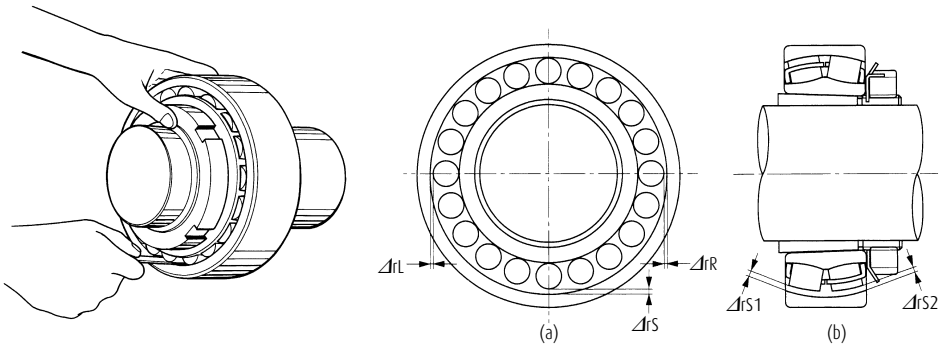



Fig. 3 Clearance Measurement Point

### 3. Temperature Equilibrium When Taking Measurements

To ensure accurate bearing measurement of the internal clearance or dimensions, the temperature of the measurement instrument and that of the components to be measured must be brought to the same temperature. Especially, if the bearing is mounted by using an oil heating tank or induction heater, then measure the internal clearance only after a complete cool down. For example, if a bearing is brought from the warehouse to the measurement place, the temperature of the stored bearing may still be high, thus, if the clearance or dimension were measured wihtout confirming the bearing temperature, the measured value may be wrong.

For a large bearing with an outer ring outside diameter that is larger than 400 mm, if a clearance or dimension measurement is necessary, it is recommended to leave the unpacked bearing for about 24 hours on the surface plate, before making a clearance or dimension measurement. Put the end face of the bearing on a surface plate prior to measurement to ensure a measurement with both objects at the same temperature.

### 4. Clearance Adjustment When Mounting Bearing on a Tapered Shaft or Sleeve

Mount the bearing with its inner ring having a tapered bore to the tapered shaft or sleeve (adapter, removable sleeve). When pushing in the bearing to the tapered shaft or sleeve, the inner ring of bearing is widened resulting in increase of "interference" and reduction of internal clearance. It is important to give proper interference and internal clearance when mounting the bearing. Next, we show the reduction amount of the clearance to achieve the proper mounting.

(Mounting of spherical roller bearings having tapered bore Table 2)

When mounting a bearing, each time the bearing is pushed further onto the tapered shaft or sleeve, measure the variation of internal clearance and repeat the above procedure until the clearance reduction amount to the specified value listed in the Table 2 is attained. This procedure is called "Clearance adjustment" and when the clearance reduction amount is attained, the clearance necessary for bearing running is secured. The confirmation of the clearance reduction amount by measurement with a thickness gauge is very important. Depending on the method of clearance adjustment, the measured value obtained with the thickness gauge may not be correct. Therefore, the following corrective procedure must be executed.

1. In case to heat

When the temperatures of bearing and shaft are both at the same room temperature, measure again the clearance with the thickness gauge to confirm that the specified value is secured.

2. In case that a lock-washer is used as a turning stopper of the lock nut.

Prior to bending the tooth of the lock-washer into cutout of lock nut, measure again the clearance with the thickness gauge to confirm that the specified value is secured.

3. In case a hydraulic nut is used

After removal of the hydraulic nut, mount the lock nut and measure the clearance again to confirm that the specified value remains constant prior to stopping the turning.

4. In case an oil injection pump is used

Drop to zero the pressure of high pressure oil fed from the oil injection pump so that there is no pressure on bearing or sleeve fitted part. Next, measure the clearance with the thickness gauge to confirm that the specified value remains secured.

#### Radial Internal Clearance and Clearance Reduction Amount of the Bearing to be Mounted

- When radial internal clearance is CN clearance (normal clearance) Perform the clearance adjustment while aiming at a middle value between minimum and maximum clearance reduction amount.
- When radial internal clearance is C3 or C4 clearance Perform the clearance adjustment aiming at the maximum clearance reduction amount.

#### Internal Clearance Adjustment of Tapered-Bore Bearings

Perform the adjustment by measuring the clearance reduction amount with the thickness gauge.

1. For measurement position and measured point, refer to Section 2.(Page B280) of this manual.
2. To mount a bearing on a tapered shaft, perform each time when the bearing is pushed in by the lock nut, end plate, end cap or hydraulic nut.
3. When using an adapter sleeve, perform each time when the bearing is pushed in by the lock nut or hydraulic nut.
4. When using a removable sleeve, perform each time when the removable sleeve is pushed in by the lock nut or hydraulic nut.

When measuring the clearance during those operations, as the outer ring of bearing is hanging down from of rollers, turn the outer ring to right and left by one half to one full rotation while keeping the bearing in its correct posture.

Position one randomly chosen roller from each row of rollers to the exact bottom position. Then, insert the thickness gauge to an appropriate place depending on size of the outer ring outside diameter to measure the internal clearance. For the clearance adjustment, the measured value of each clearance measurement shall be recorded.

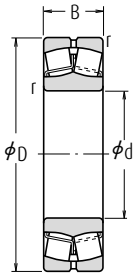
## Table 2 Mounting of Spherical Roller Bearings with Tapered Bores

Units : mm

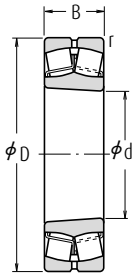
| Bearing Bore Diameter d (mm) | | Reduction in Radial Clearance | | Axial Movement | | | | Minimum Permissible Residual Clearance | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Taper 1:12 | | Taper 1:30 | | | | |
| over | incl. | min. | max. | min. | max. | min. | max. | CN | C3 | C4 |
| 30 | 40 | 0.025 | 0.030 | 0.40 | 0.45 | — | — | 0.010 | 0.025 | 0.035 |
| 40 | 50 | 0.030 | 0.035 | 0.45 | 0.55 | — | — | 0.015 | 0.030 | 0.045 |
| 50 | 65 | 0.030 | 0.035 | 0.45 | 0.55 | — | — | 0.025 | 0.035 | 0.060 |
| 65 | 80 | 0.040 | 0.045 | 0.60 | 0.70 | — | — | 0.030 | 0.040 | 0.075 |
| 80 | 100 | 0.045 | 0.055 | 0.70 | 0.85 | 1.75 | 2.15 | 0.035 | 0.050 | 0.085 |
| 100 | 120 | 0.050 | 0.060 | 0.75 | 0.90 | 1.9 | 2.25 | 0.045 | 0.065 | 0.110 |
| 120 | 140 | 0.060 | 0.070 | 0.90 | 1.1 | 2.25 | 2.75 | 0.055 | 0.080 | 0.130 |
| 140 | 160 | 0.065 | 0.080 | 1.0 | 1.3 | 2.5 | 3.25 | 0.060 | 0.100 | 0.150 |
| 160 | 180 | 0.070 | 0.090 | 1.1 | 1.4 | 2.75 | 3.5 | 0.070 | 0.110 | 0.170 |
| 180 | 200 | 0.080 | 0.100 | 1.3 | 1.6 | 3.25 | 4.0 | 0.070 | 0.110 | 0.190 |
| 200 | 225 | 0.090 | 0.110 | 1.4 | 1.7 | 3.5 | 4.25 | 0.080 | 0.130 | 0.210 |
| 225 | 250 | 0.100 | 0.120 | 1.6 | 1.9 | 4.0 | 4.75 | 0.090 | 0.140 | 0.230 |
| 250 | 280 | 0.110 | 0.140 | 1.7 | 2.2 | 4.25 | 5.5 | 0.100 | 0.150 | 0.250 |
| 280 | 315 | 0.120 | 0.150 | 1.9 | 2.4 | 4.75 | 6.0 | 0.110 | 0.160 | 0.280 |
| 315 | 355 | 0.140 | 0.170 | 2.2 | 2.7 | 5.5 | 6.75 | 0.120 | 0.180 | 0.300 |
| 355 | 400 | 0.150 | 0.190 | 2.4 | 3.0 | 6.0 | 7.5 | 0.130 | 0.200 | 0.330 |
| 400 | 450 | 0.170 | 0.210 | 2.7 | 3.3 | 6.75 | 8.25 | 0.140 | 0.220 | 0.360 |
| 450 | 500 | 0.190 | 0.240 | 3.0 | 3.7 | 7.5 | 9.25 | 0.160 | 0.240 | 0.390 |
| 500 | 560 | 0.210 | 0.270 | 3.4 | 4.3 | 8.5 | 11.0 | 0.170 | 0.270 | 0.410 |
| 560 | 630 | 0.230 | 0.300 | 3.7 | 4.8 | 9.25 | 12.0 | 0.200 | 0.310 | 0.460 |
| 630 | 710 | 0.260 | 0.330 | 4.2 | 5.3 | 10.5 | 13.0 | 0.220 | 0.330 | 0.520 |
| 710 | 800 | 0.280 | 0.370 | 4.5 | 5.9 | 11.5 | 15.0 | 0.240 | 0.390 | 0.590 |
| 800 | 900 | 0.310 | 0.410 | 5.0 | 6.6 | 12.5 | 16.5 | 0.280 | 0.430 | 0.660 |
| 900 | 1 000 | 0.340 | 0.460 | 5.5 | 7.4 | 14.0 | 18.5 | 0.310 | 0.470 | 0.730 |
| 1 000 | 1 120 | 0.370 | 0.500 | 5.9 | 8.0 | 15.0 | 20.0 | 0.360 | 0.530 | 0.800 |

**Remarks** The values for reduction in radial internal clearance are for bearings with CN clearance.
For bearings with C3 or C4 Clearance, the maximum values listed should be used for the reduction in radial internal clearance.

## Bore Diameter 20 – 55 mm




Cylindrical Bore
EA



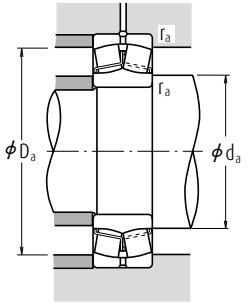

Tapered Bore
EA



Without an Oil Groove or Holes
CD

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Thermal Reference Speed | Speeds ($min^{-1}$) | | Bearing |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Limiting Speeds | | |
| d | D | B | r min. | $C_r$ | $C_{0r}$ | | Mechanical | Grease | Cylindrical Bore |
| **20** | 52 | 15 | 1.1 | 29 300 | 26 900 | 10 000 | – | 6 300 | **21304CDE4** |
| **25** | 52 | 18 | 1.0 | 37 500 | 37 000 | 10 000 | – | 7 100 | **22205CE4** |
| | 62 | 17 | 1.1 | 43 000 | 40 500 | 9 000 | – | 5 300 | **21305CDE4** |
| **30** | 62 | 20 | 1.0 | 50 000 | 50 000 | 8 500 | – | 6 000 | **22206CE4** |
| | 72 | 19 | 1.1 | 55 000 | 54 000 | 7 500 | – | 4 500 | **21306CDE4** |
| **35** | 72 | 23 | 1.1 | 69 000 | 71 000 | 7 500 | – | 5 300 | **22207CE4** |
| | 80 | 21 | 1.5 | 71 500 | 76 000 | 7 100 | – | 4 000 | **21307CDE4** |
| **40** | 80 | 23 | 1.1 | 113 000 | 99 000 | 7 100 | 12 000 | 6 700 | **22208EAE4**[*] |
| | 90 | 23 | 1.5 | 118 000 | 111 000 | 6 700 | 11 000 | 6 000 | **21308EAE4**[*] |
| | 90 | 33 | 1.5 | 170 000 | 153 000 | 5 600 | 9 000 | 5 300 | **22308EAE4**[*] |
| **45** | 85 | 23 | 1.1 | 118 000 | 111 000 | 6 300 | 11 000 | 6 000 | **22209EAE4**[*] |
| | 100 | 25 | 1.5 | 149 000 | 144 000 | 6 000 | 9 000 | 5 000 | **21309EAE4**[*] |
| | 100 | 36 | 1.5 | 207 000 | 195 000 | 5 000 | 8 000 | 4 500 | **22309EAE4**[*] |
| **50** | 90 | 23 | 1.1 | 124 000 | 119 000 | 6 000 | 9 500 | 5 600 | **22210EAE4**[*] |
| | 110 | 27 | 2.0 | 178 000 | 174 000 | 5 300 | 8 000 | 4 500 | **21310EAE4**[*] |
| | 110 | 40 | 2.0 | 246 000 | 234 000 | 4 800 | 7 100 | 4 300 | **22310EAE4**[*] |
| **55** | 100 | 25 | 1.5 | 149 000 | 144 000 | 5 300 | 9 000 | 5 300 | **22211EAE4**[*] |
| | 120 | 29 | 2.0 | 178 000 | 174 000 | 5 300 | 8 000 | 4 500 | **21311EAE4**[*] |
| | 120 | 43 | 2.0 | 292 000 | 292 000 | 4 300 | 6 000 | 3 800 | **22311EAE4**[*] |

**Note** (1) The suffix K represents bearings with tapered bores (taper 1 : 12).




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | $Y_3$ | 0.67 | $Y_2$ |

## Static Equivalent Load

$P_0=F_r+Y_0F_a$

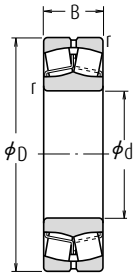
The values of e, $Y_2$ , $Y_3$ and $Y_0$ are given in the table below.

| Numbers | Abutment and Fillet Dimensions (mm) | | | | | Constant | Axial Load Factors | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $d_a$ | | $D_a$ | | $r_a$ | | | | | |
| Tapered Bore (1) | min. | max. | max. | min. | max. | e | $Y_2$ | $Y_3$ | $Y_0$ | approx. |
| **21304CDKE4** | 27 | 28 | 45 | 42 | 1.0 | 0.31 | 3.2 | 2.1 | 2.1 | 0.17 |
| **22205CKE4** | 31 | 31 | 46 | 45 | 1.0 | 0.35 | 2.9 | 1.9 | 1.9 | 0.17 |
| **21305CDKE4** | 32 | 34 | 55 | 51 | 1.0 | 0.29 | 3.4 | 2.3 | 2.3 | 0.26 |
| **22206CKE4** | 36 | 37 | 56 | 54 | 1.0 | 0.33 | 3.1 | 2.1 | 2.0 | 0.27 |
| **21306CDKE4** | 37 | 40 | 65 | 59 | 1.0 | 0.28 | 3.6 | 2.4 | 2.3 | 0.39 |
| **22207CKE4** | 42 | 43 | 65 | 63 | 1.0 | 0.32 | 3.1 | 2.1 | 2.0 | 0.42 |
| **21307CDKE4** | 44 | 47 | 71 | 67 | 1.5 | 0.28 | 3.6 | 2.4 | 2.4 | 0.53 |
| **22208EAKE4*** | 47 | 49 | 73 | 70 | 1.0 | 0.28 | 3.6 | 2.4 | 2.4 | 0.50 |
| **21308EAKE4*** | 49 | 55 | 81 | 75 | 1.5 | 0.25 | 3.9 | 2.7 | 2.6 | 0.73 |
| **22308EAKE4*** | 49 | 52 | 81 | 77 | 1.5 | 0.35 | 2.8 | 1.9 | 1.9 | 0.98 |
| **22209EAKE4*** | 52 | 55 | 78 | 75 | 1.0 | 0.25 | 3.9 | 2.7 | 2.6 | 0.55 |
| **21309EAKE4*** | 54 | 65 | 91 | 89 | 1.5 | 0.23 | 4.3 | 2.9 | 2.8 | 0.96 |
| **22309EAKE4*** | 54 | 60 | 91 | 86 | 1.5 | 0.34 | 2.9 | 2.0 | 1.9 | 1.34 |
| **22210EAKE4*** | 57 | 60 | 83 | 81 | 1.0 | 0.24 | 4.3 | 2.9 | 2.8 | 0.61 |
| **21310EAKE4*** | 60 | 72 | 100 | 98 | 2.0 | 0.23 | 4.4 | 3.0 | 2.9 | 1.21 |
| **22310EAKE4*** | 60 | 64 | 100 | 93 | 2.0 | 0.35 | 2.8 | 1.9 | 1.9 | 1.78 |
| **22211EAKE4*** | 64 | 65 | 91 | 89 | 1.5 | 0.23 | 4.3 | 2.9 | 2.8 | 0.81 |
| **21311EAKE4*** | 65 | 72 | 110 | 98 | 2.0 | 0.23 | 4.4 | 3.0 | 2.9 | 1.58 |
| **22311EAKE4*** | 65 | 73 | 110 | 103 | 2.0 | 0.34 | 2.9 | 2.0 | 1.9 | 2.3 |

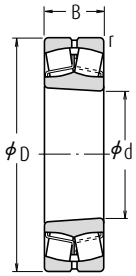
**Remarks**

1. The bearings denoted by an asterisk (*) are NSKHPS bearings and an oil groove and holes are standard for them.
2. When making a selection of the recommended fit (Tolerance of shaft) on Page A164, in case of NSKHPS bearings, the conditions are different.
   The segmentations are: Light Loads ($\leqq 0.05C_r$); Normal Loads (0.05 to $0.10C_r$); and Heavy Loads ($>0.10C_r$).
3. For the dimensions of adapters and withdrawal sleeves, refer to Pages **B376 – B377, and B384**.

## Bore Diameter 60 – 90 mm




Cylindrical Bore
EA



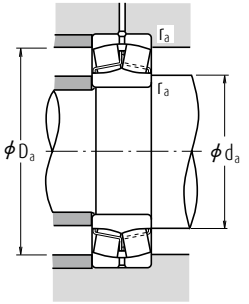

Tapered Bore
EA



Without an Oil Groove or Holes
CD

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Thermal Reference Speed | Speeds ($min^{-1}$) | | Bearing |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Limiting Speeds | | |
| d | D | B | r min. | $C_r$ | $C_{0r}$ | | Mechanical | Grease | Cylindrical Bore |
| **60** | 95 | 26.0 | 1.1 | 98 500 | 141 000 | 4 800 | – | 3 600 | **23012CE4** |
| | 110 | 28.0 | 1.5 | 178 000 | 174 000 | 5 300 | 8 000 | 4 800 | **22212EAE4*** |
| | 130 | 31.0 | 2.1 | 238 000 | 244 000 | 4 800 | 6 700 | 3 800 | **21312EAE4*** |
| | 130 | 46.0 | 2.1 | 340 000 | 340 000 | 4 000 | 5 600 | 3 600 | **22312EAE4*** |
| **65** | 120 | 31.0 | 1.5 | 221 000 | 230 000 | 4 800 | 7 500 | 4 300 | **22213EAE4*** |
| | 140 | 33.0 | 2.1 | 264 000 | 275 000 | 4 500 | 6 000 | 3 600 | **21313EAE4*** |
| | 140 | 48.0 | 2.1 | 375 000 | 380 000 | 3 800 | 5 000 | 3 200 | **22313EAE4*** |
| **70** | 125 | 31.0 | 1.5 | 225 000 | 232 000 | 4 500 | 7 100 | 4 000 | **22214EAE4*** |
| | 150 | 35.0 | 2.1 | 310 000 | 325 000 | 4 300 | 5 600 | 3 200 | **21314EAE4*** |
| | 150 | 51.0 | 2.1 | 425 000 | 435 000 | 3 600 | 4 800 | 3 000 | **22314EAE4*** |
| **75** | 130 | 31.0 | 1.5 | 238 000 | 244 000 | 4 300 | 6 700 | 4 000 | **22215EAE4*** |
| | 160 | 37.0 | 2.1 | 310 000 | 325 000 | 4 000 | 5 600 | 3 200 | **21315EAE4*** |
| | 160 | 55.0 | 2.1 | 485 000 | 505 000 | 3 400 | 4 300 | 2 800 | **22315EAE4*** |
| **80** | 140 | 33.0 | 2.0 | 264 000 | 275 000 | 4 000 | 6 000 | 3 600 | **22216EAE4*** |
| | 170 | 39.0 | 2.1 | 355 000 | 375 000 | 3 800 | 4 800 | 3 000 | **21316EAE4*** |
| | 170 | 58.0 | 2.1 | 540 000 | 565 000 | 3 200 | 3 800 | 2 600 | **22316EAE4*** |
| **85** | 150 | 36.0 | 2.0 | 310 000 | 325 000 | 4 000 | 5 600 | 3 400 | **22217EAE4*** |
| | 180 | 41.0 | 3.0 | 360 000 | 395 000 | 3 800 | 5 000 | 3 000 | **21317EAE4*** |
| | 180 | 60.0 | 3.0 | 600 000 | 630 000 | 3 000 | 3 400 | 2 400 | **22317EAE4*** |
| **90** | 160 | 40.0 | 2.0 | 360 000 | 395 000 | 3 800 | 5 000 | 3 200 | **22218EAE4*** |
| | 160 | 52.4 | 2.0 | 340 000 | 490 000 | 2 800 | – | 1 800 | **23218CE4** |
| | 190 | 43.0 | 3.0 | 415 000 | 450 000 | 3 600 | 4 500 | 2 800 | **21318EAE4*** |
| | 190 | 64.0 | 3.0 | 665 000 | 705 000 | 2 800 | 3 000 | 2 400 | **22318EAE4*** |

**Note** (1) The suffix K represents bearings with tapered bores (taper 1 : 12).




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | $Y_3$ | 0.67 | $Y_2$ |

## Static Equivalent Load

$P_0=F_r+Y_0F_a$

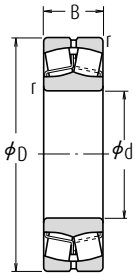
The values of e, $Y_2$ , $Y_3$ and $Y_0$ are given in the table below.

| Numbers | Abutment and Fillet Dimensions (mm) | | | | | Constant | Axial Load Factors | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| Tapered Bore (1) | $d_a$ min. | $d_a$ max. | $D_a$ max. | $D_a$ min. | $r_a$ max. | e | $Y_2$ | $Y_3$ | $Y_0$ | approx. |
| **23012CKE4** | 67 | 68 | 88 | 85 | 1 | 0.26 | 3.9 | 2.6 | 2.5 | 0.68 |
| **22212EAKE4*** | 69 | 72 | 101 | 98 | 1.5 | 0.23 | 4.4 | 3.0 | 2.9 | 1.1 |
| **21312EAKE4*** | 72 | 87 | 118 | 117 | 2 | 0.22 | 4.5 | 3.0 | 3.0 | 1.98 |
| **22312EAKE4*** | 72 | 79 | 118 | 111 | 2 | 0.34 | 3.0 | 2.0 | 1.9 | 2.89 |
| **22213EAKE4*** | 74 | 80 | 111 | 107 | 1.5 | 0.24 | 4.2 | 2.8 | 2.7 | 1.51 |
| **21313EAKE4*** | 77 | 94 | 128 | 126 | 2 | 0.22 | 4.6 | 3.1 | 3.0 | 2.45 |
| **22313EAKE4*** | 77 | 84 | 128 | 119 | 2 | 0.34 | 3.0 | 2.0 | 2.0 | 3.52 |
| **22214EAKE4*** | 79 | 84 | 116 | 111 | 1.5 | 0.23 | 4.3 | 2.9 | 2.8 | 1.58 |
| **21314EAKE4*** | 82 | 101 | 138 | 135 | 2 | 0.22 | 4.6 | 3.1 | 3.0 | 3.0 |
| **22314EAKE4*** | 82 | 91 | 138 | 129 | 2 | 0.33 | 3.0 | 2.0 | 2.0 | 4.28 |
| **22215EAKE4*** | 84 | 87 | 121 | 117 | 1.5 | 0.22 | 4.5 | 3.0 | 3.0 | 1.64 |
| **21315EAKE4*** | 87 | 101 | 148 | 134 | 2 | 0.22 | 4.6 | 3.1 | 3.0 | 3.64 |
| **22315EAKE4*** | 87 | 97 | 148 | 137 | 2 | 0.33 | 3.0 | 2.0 | 2.0 | 5.26 |
| **22216EAKE4*** | 90 | 94 | 130 | 126 | 2 | 0.22 | 4.6 | 3.1 | 3.0 | 2.01 |
| **21316EAKE4*** | 92 | 109 | 158 | 146 | 2 | 0.23 | 4.4 | 3.0 | 2.9 | 4.32 |
| **22316EAKE4*** | 92 | 103 | 158 | 145 | 2 | 0.33 | 3.0 | 2.0 | 2.0 | 6.23 |
| **22217EAKE4*** | 95 | 101 | 140 | 135 | 2 | 0.22 | 4.6 | 3.1 | 3.0 | 2.54 |
| **21317EAKE4*** | 99 | 108 | 166 | 142 | 2.5 | 0.24 | 4.3 | 2.9 | 2.8 | 5.2 |
| **22317EAKE4*** | 99 | 110 | 166 | 155 | 2.5 | 0.33 | 3.1 | 2.1 | 2.0 | 7.23 |
| **22218EAKE4*** | 100 | 108 | 150 | 142 | 2 | 0.24 | 4.3 | 2.9 | 2.8 | 3.3 |
| **23218CKE4** | 100 | 105 | 150 | 138 | 2 | 0.32 | 3.2 | 2.1 | 2.1 | 4.51 |
| **21318EAKE4*** | 104 | 115 | 176 | 152 | 2.5 | 0.24 | 4.3 | 2.9 | 2.8 | 6.1 |
| **22318EAKE4*** | 104 | 115 | 176 | 163 | 2.5 | 0.33 | 3.1 | 2.1 | 2.0 | 8.56 |

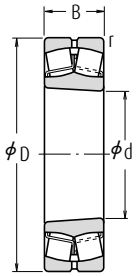
**Remarks**

1. The bearings denoted by an asterisk (*) are NSKHPS bearings and an oil groove and holes are standard for them.
2. When making a selection of the recommended fit (Tolerance of shaft) on Page A164, in case of NSKHPS bearings, the conditions are different.
   The segmentations are: Light Loads ($\leqq 0.05C_r$); Normal Loads (0.05 to $0.10C_r$); and Heavy Loads ($>0.10C_r$).
3. For the dimensions of adapters and withdrawal sleeves, refer to Pages **B376 – B379, and B384 – B385**.

## Bore Diameter 95 – 110 mm




Cylindrical Bore
EA



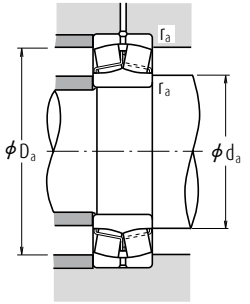

Tapered Bore
EA



Without an Oil Groove or Holes
CD

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Thermal Reference Speed | Speeds ($min^{-1}$) | | Bearing |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Limiting Speeds | | |
| d | D | B | r min. | $C_r$ | $C_{0r}$ | | Mechanical | Grease | Cylindrical Bore |
| **95** | 170 | 43.0 | 2.1 | 415 000 | 450 000 | 3 800 | 4 500 | 3 000 | **22219EAE4*** |
| | 170 | 55.6 | 2.1 | 370 000 | 525 000 | 2 600 | — | 1 700 | **23219CAME4** |
| | 200 | 45.0 | 3.0 | 430 000 | 435 000 | 3 600 | — | 1 500 | **21319CAME4*** |
| | 200 | 45.0 | 3.0 | 430 000 | 435 000 | 3 400 | — | 1 500 | **21319CE4** |
| | 200 | 67.0 | 3.0 | 735 000 | 780 000 | 2 600 | 3 000 | 2 200 | **22319EAE4*** |
| **100** | 150 | 37.0 | 1.5 | 212 000 | 335 000 | 3 200 | — | 2 200 | **23020CDE4** |
| | 150 | 50.0 | 1.5 | 276 000 | 470 000 | 2 800 | — | 1 800 | **24020CE4** |
| | 165 | 52.0 | 2.0 | 345 000 | 530 000 | 2 800 | — | 1 700 | **23120CE4** |
| | 165 | 65.0 | 2.0 | 345 000 | 535 000 | 2 400 | — | 1 700 | **24120CAME4** |
| | 180 | 46.0 | 2.1 | 455 000 | 490 000 | 3 600 | 4 300 | 2 800 | **22220EAE4*** |
| | 180 | 60.3 | 2.1 | 525 000 | 605 000 | 2 800 | 3 800 | 1 600 | **23220CAME4*** |
| | 180 | 60.3 | 2.1 | 525 000 | 605 000 | 2 600 | — | 1 600 | **23220CE4** |
| | 215 | 47.0 | 3.0 | 495 000 | 485 000 | 3 400 | 4 500 | 1 400 | **21320CAME4*** |
| | 215 | 47.0 | 3.0 | 495 000 | 485 000 | 3 200 | — | 1 400 | **21320CE4** |
| | 215 | 73.0 | 3.0 | 750 000 | 785 000 | 2 600 | 3 400 | 1 700 | **22320CAME4(2)*** |
| **110** | 170 | 45.0 | 2.0 | 293 000 | 465 000 | 3 200 | — | 2 000 | **23022CDE4** |
| | 170 | 60.0 | 2.0 | 380 000 | 645 000 | 2 600 | — | 1 600 | **24022CE4** |
| | 180 | 56.0 | 2.0 | 480 000 | 630 000 | 3 200 | 4 000 | 1 600 | **23122CAME4*** |
| | 180 | 56.0 | 2.0 | 480 000 | 630 000 | 2 600 | — | 1 600 | **23122CE4** |
| | 180 | 69.0 | 2.0 | 575 000 | 750 000 | 2 200 | 3 400 | 1 600 | **24122CAME4*** |
| | 180 | 69.0 | 2.0 | 575 000 | 750 000 | 2 000 | — | 1 600 | **24122CE4** |
| | 200 | 53.0 | 2.1 | 605 000 | 645 000 | 3 400 | 3 400 | 2 600 | **22222EAE4*** |
| | 200 | 69.8 | 2.1 | 645 000 | 760 000 | 2 600 | 3 400 | 1 500 | **23222CAME4*** |
| | 200 | 69.8 | 2.1 | 645 000 | 760 000 | 2 200 | — | 1 500 | **23222CE4** |
| | 240 | 50.0 | 3.0 | 450 000 | 545 000 | 3 000 | — | 1 300 | **21322CAE4** |
| | 240 | 50.0 | 3.0 | 565 000 | 545 000 | 3 000 | 4 300 | 1 300 | **21322CAME4*** |
| | 240 | 80.0 | 3.0 | 1 030 000 | 1 120 000 | 2 200 | — | 1 500 | **22322EAE4*** |
| | 240 | 80.0 | 3.0 | 925 000 | 980 000 | 2 200 | 3 000 | 1 500 | **22322CAME4(2)*** |

**Notes** (1) The suffix K or K30 represents bearings with tapered bores (taper 1 : 12 or 1 : 30).
(2) EA is also available. Load rating of EA is around 10% higher than CAM's, please consult NSK.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | $Y_3$ | 0.67 | $Y_2$ |

## Static Equivalent Load

$P_0=F_r+Y_0F_a$

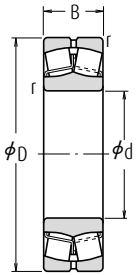
The values of e, $Y_2$ , $Y_3$ and $Y_0$ are given in the table below.

| Numbers | Abutment and Fillet Dimensions (mm) | | | | | Constant | Axial Load Factors | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $d_a$ | | $D_a$ | | $r_a$ | | | | | |
| Tapered Bore (1) | min. | max. | max. | min. | max. | e | $Y_2$ | $Y_3$ | $Y_0$ | approx. |
| **22219EAKE4*** | 107 | 115 | 158 | 152 | 2 | 0.24 | 4.3 | 2.9 | 2.8 | 4.04 |
| **23219CAMKE4** | 107 | — | 158 | 146 | 2 | 0.32 | 3.1 | 2.1 | 2.0 | 5.33 |
| **23219CAMKE4** | 109 | 127 | 186 | 172 | 2.5 | 0.22 | 4.6 | 3.1 | 3.0 | 6.92 |
| **21319CKE4** | 109 | 127 | 186 | 172 | 2.5 | 0.22 | 4.6 | 3.1 | 3.0 | 6.92 |
| **22319EAKE4** | 109 | 121 | 186 | 172 | 2.5 | 0.33 | 3.1 | 2.1 | 2.0 | 9.91 |
| **23020CDKE4** | 109 | 112 | 141 | 136 | 1.5 | 0.22 | 4.6 | 3.1 | 3.0 | 2.31 |
| **24020CK30E4** | 109 | 110 | 141 | 132 | 1.5 | 0.30 | 3.4 | 2.3 | 2.2 | 3.08 |
| **23120CKE4** | 110 | 113 | 155 | 144 | 2 | 0.30 | 3.4 | 2.3 | 2.2 | 4.38 |
| **24120CAMK30E4** | 110 | — | 155 | 143 | 2 | 0.35 | 2.9 | 1.9 | 1.9 | 5.42 |
| **22220EAKE4*** | 112 | 119 | 168 | 160 | 2 | 0.24 | 4.3 | 2.9 | 2.8 | 4.84 |
| **23220CAMKE4*** | 112 | 118 | 168 | 155 | 2 | 0.32 | 3.2 | 2.1 | 2.1 | 6.6 |
| **23220CKE4** | 112 | 118 | 168 | 155 | 2 | 0.32 | 3.2 | 2.1 | 2.1 | 6.6 |
| **21320CAMKE4*** | 114 | 133 | 201 | 184 | 2.5 | 0.23 | 4.4 | 3.0 | 2.9 | 8.46 |
| **21320CKE4** | 114 | 133 | 201 | 184 | 2.5 | 0.21 | 4.7 | 3.2 | 3.1 | 8.46 |
| **22320CAMKE4(2)*** | 114 | 130 | 201 | 184 | 2.5 | 0.35 | 2.9 | 1.9 | 1.9 | 12.7 |
| **23022CDKE4** | 120 | 124 | 160 | 153 | 2 | 0.24 | 4.2 | 2.8 | 2.8 | 3.76 |
| **24022CK30E4** | 120 | 121 | 160 | 148 | 2 | 0.32 | 3.1 | 2.1 | 2.1 | 4.96 |
| **23122CAMKE4*** | 120 | 127 | 170 | 158 | 2 | 0.28 | 3.5 | 2.4 | 2.3 | 5.7 |
| **23122CKE4** | 120 | 127 | 170 | 158 | 2 | 0.29 | 3.6 | 2.4 | 2.3 | 5.8 |
| **24122CAMK30E4*** | 120 | 123 | 170 | 154 | 2 | 0.36 | 2.8 | 1.9 | 1.8 | 6.84 |
| **24122CK30E4** | 120 | 123 | 170 | 154 | 2 | 0.37 | 2.9 | 1.9 | 1.8 | 6.85 |
| **22222EAKE4*** | 122 | 129 | 188 | 178 | 2 | 0.25 | 4.0 | 2.7 | 2.6 | 6.99 |
| **23222CAMKE4*** | 122 | 130 | 188 | 170 | 2 | 0.34 | 3.0 | 2.0 | 1.9 | 9.54 |
| **23222CKE4** | 122 | 130 | 188 | 170 | 2 | 0.35 | 3.1 | 2.1 | 1.10 | 9.55 |
| **21322CAKE4** | 124 | — | 226 | 206 | 2.5 | 0.22 | 4.6 | 3.1 | 3.0 | 11.2 |
| **21322CAMKE4*** | 124 | — | 226 | 206 | 2.5 | 0.22 | 4.6 | 3.1 | 3.0 | 11.2 |
| **22322EAKE4*** | 124 | 145 | 226 | 206 | 2.5 | 0.33 | 3.1 | 2.1 | 2.0 | 17.6 |
| **22322CAMKE4(2)*** | 124 | 145 | 226 | 206 | 2.5 | 0.33 | 3.1 | 2.1 | 2.0 | 17.6 |

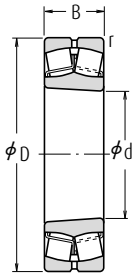
**Remarks**

1. The bearings denoted by an asterisk (*) are NSKHPS bearings and an oil groove and holes are standard for them.
2. When making a selection of the recommended fit (Tolerance of Shaft) on Page A164, in case of NSKHPS bearings, the conditions are different.
   The segmentations are: Light Loads ($\leqq 0.05C_r$); Normal Loads ($0.05$ to $0.10C_r$); and Heavy Loads ($>0.10C_r$).
3. For the dimensions of adapters and withdrawal sleeves, refer to Pages **B379 and B385.**

## Bore Diameter 120 – 130 mm




Cylindrical Bore
EA




Tapered Bore
EA

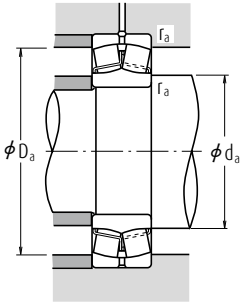


Without an Oil Groove or Holes
CD

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Thermal Reference Speed | Speeds ($min^{-1}$) | | Bearing |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Limiting Speeds | | |
| d | D | B | r min. | $C_r$ | $C_{0r}$ | | Mechanical | Grease | Cylindrical Bore |
| **120** | 180 | 46.0 | 2.0 | 395 000 | 525 000 | 3 200 | 4 500 | 1 800 | **23024CAME4** * |
| | 180 | 46.0 | 2.0 | 395 000 | 525 000 | 2 800 | — | 1 800 | **23024CDE4** |
| | 180 | 60.0 | 2.0 | 480 000 | 680 000 | 2 600 | 3 600 | 1 500 | **24024CAME4** * |
| | 180 | 60.0 | 2.0 | 480 000 | 680 000 | 2 400 | — | 1 500 | **24024CE4** |
| | 200 | 62.0 | 2.0 | 580 000 | 720 000 | 2 800 | 3 600 | 1 400 | **23124CAME4** * |
| | 200 | 62.0 | 2.0 | 580 000 | 720 000 | 2 400 | — | 1 400 | **23124CE4** |
| | 200 | 80.0 | 2.0 | 695 000 | 905 000 | 2 000 | 3 000 | 1 400 | **24124CAME4** * |
| | 200 | 80.0 | 2.0 | 695 000 | 905 000 | 1 800 | — | 1 400 | **24124CE4** |
| | 215 | 58.0 | 2.1 | 685 000 | 765 000 | 3 200 | 3 000 | 2 400 | **22224EAE4** * |
| | 215 | 76.0 | 2.1 | 790 000 | 970 000 | 2 200 | 3 000 | 1 300 | **23224CAME4** * |
| | 215 | 76.0 | 2.1 | 790 000 | 970 000 | 2 000 | — | 1 300 | **23224CE4** |
| | 260 | 86.0 | 3.0 | 1 190 000 | 1 320 000 | — | — | — | **22324EAE4*** |
| | 260 | 86.0 | 3.0 | 1 060 000 | 1 120 000 | 2 000 | 2 800 | 1 400 | **22324CAME4**(2) * |
| **130** | 200 | 52.0 | 2.0 | 500 000 | 655 000 | 3 000 | 3 800 | 1 700 | **23026CAME4** * |
| | 200 | 52.0 | 2.0 | 500 000 | 655 000 | 2 800 | — | 1 700 | **23026CDE4** |
| | 200 | 69.0 | 2.0 | 620 000 | 865 000 | 2 200 | 3 200 | 1 400 | **24026CAME4** * |
| | 200 | 69.0 | 2.0 | 620 000 | 865 000 | 2 200 | — | 1 400 | **24026CE4** |
| | 210 | 64.0 | 2.0 | 630 000 | 825 000 | 2 200 | 3 400 | 1 300 | **23126CAME4** * |
| | 210 | 64.0 | 2.0 | 630 000 | 825 000 | 2 200 | — | 1 300 | **23126CE4** |
| | 210 | 80.0 | 2.0 | 735 000 | 1 010 000 | 1 800 | 2 800 | 1 300 | **24126CAME4** * |
| | 210 | 80.0 | 2.0 | 735 000 | 1 010 000 | 1 600 | — | 1 300 | **24126CE4** |
| | 230 | 64.0 | 3.0 | 820 000 | 940 000 | 2 800 | 2 600 | 2 200 | **22226EAE4** * |
| | 230 | 80.0 | 3.0 | 875 000 | 1 080 000 | 2 000 | 2 800 | 1 200 | **23226CAME4** * |
| | 230 | 80.0 | 3.0 | 875 000 | 1 080 000 | 1 800 | — | 1 200 | **23226CE4** |
| | 280 | 93.0 | 4.0 | 1 240 000 | 1 350 000 | 1 800 | 2 600 | 1 300 | **22326CAME4** * |
| | 280 | 93.0 | 4.0 | 1 240 000 | 1 350 000 | 1 900 | — | 1 300 | **22326CE4** |

**Notes**

(1) The suffix K or K30 represents bearings with tapered bores (taper 1 : 12 or 1 : 30).
(2) EA is also available. Load rating of EA is around 10% higher than CAM's, please consult NSK.




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | $Y_3$ | 0.67 | $Y_2$ |

## Static Equivalent Load

$P_0=F_r+Y_0F_a$

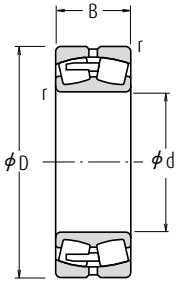
The values of e, $Y_2$ , $Y_3$ and $Y_0$ are given in the table below.

| Numbers | Abutment and Fillet Dimensions (mm) | | | | | Constant | Axial Load Factors | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $d_a$ | | $D_a$ | | $r_a$ | | | | | |
| Tapered Bore (1) | min. | max. | max. | min. | max. | e | $Y_2$ | $Y_3$ | $Y_0$ | approx. |
| **23024CAMKE4** * | 130 | 134 | 170 | 163 | 2 | 0.22 | 4.5 | 3.0 | 2.9 | 4.11 |
| **23024CDKE4** | 130 | 134 | 170 | 163 | 2 | 0.22 | 4.5 | 3.0 | 2.9 | 4.11 |
| **24024CAMK30E4** * | 130 | 131 | 170 | 158 | 2 | 0.32 | 3.2 | 2.1 | 2.1 | 5.33 |
| **24024CK30E4** | 130 | 131 | 170 | 158 | 2 | 0.32 | 3.2 | 2.1 | 2.1 | 5.33 |
| **23124CAMKE4** * | 130 | 138 | 190 | 175 | 2 | 0.29 | 3.5 | 2.4 | 2.3 | 7.85 |
| **23124CKE4** | 130 | 138 | 190 | 175 | 2 | 0.29 | 3.5 | 2.4 | 2.3 | 7.85 |
| **24124CAMK30E4** * | 130 | 136 | 190 | 171 | 2 | 0.37 | 2.7 | 1.8 | 1.8 | 10 |
| **24124CK30E4** | 130 | 136 | 190 | 171 | 2 | 0.37 | 2.7 | 1.8 | 1.8 | 10 |
| **22224EAKE4** * | 132 | 142 | 203 | 190 | 2 | 0.25 | 3.9 | 2.7 | 2.6 | 8.8 |
| **23224CAMKE4** * | 132 | 140 | 203 | 182 | 2 | 0.35 | 2.9 | 1.9 | 1.9 | 12.1 |
| **23224CKE4** | 132 | 140 | 203 | 182 | 2 | 0.34 | 2.9 | 2.0 | 1.9 | 12.1 |
| **22324EAKE4*** | 134 | 157 | 246 | 222 | 2.5 | 0.32 | 3.1 | 2.1 | 2.0 | 22.2 |
| **22324CAMKE4**(2) * | 134 | 157 | 246 | 222 | 2.5 | 0.32 | 3.1 | 2.1 | 2.0 | 22.2 |
| **23026CAMKE4** * | 140 | 147 | 190 | 180 | 2 | 0.23 | 4.3 | 2.9 | 2.8 | 5.98 |
| **23026CDKE4** | 140 | 147 | 190 | 180 | 2 | 0.23 | 4.3 | 2.9 | 2.8 | 5.98 |
| **24026CAMK30E4** * | 140 | 143 | 190 | 175 | 2 | 0.31 | 3.2 | 2.2 | 2.1 | 7.84 |
| **24026CK30E4** | 140 | 143 | 190 | 175 | 2 | 0.31 | 3.2 | 2.2 | 2.1 | 7.84 |
| **23126CAMKE4** * | 140 | 149 | 200 | 184 | 2 | 0.28 | 3.6 | 2.4 | 2.4 | 8.69 |
| **23126CKE4** | 140 | 149 | 200 | 184 | 2 | 0.28 | 3.6 | 2.4 | 2.4 | 8.69 |
| **24126CAMK30E4** * | 140 | 146 | 200 | 180 | 2 | 0.37 | 2.7 | 1.8 | 1.8 | 10.7 |
| **24126CK30E4** | 140 | 146 | 200 | 180 | 2 | 0.35 | 2.9 | 1.9 | 1.9 | 10.7 |
| **22226EAKE4** * | 144 | 152 | 216 | 204 | 2.5 | 0.26 | 3.8 | 2.6 | 2.5 | 11 |
| **23226CAMKE4** * | 144 | 150 | 216 | 196 | 2.5 | 0.34 | 2.9 | 2.0 | 1.9 | 14.3 |
| **23226CKE4** | 144 | 150 | 216 | 196 | 2.5 | 0.34 | 2.9 | 2.0 | 1.9 | 14.3 |
| **22326CAMKE4** * | 148 | 166 | 262 | 236 | 3 | 0.34 | 2.9 | 2.0 | 1.9 | 28.1 |
| **22326CKE4** | 148 | 166 | 262 | 236 | 3 | 0.34 | 2.9 | 2.0 | 1.9 | 28.1 |

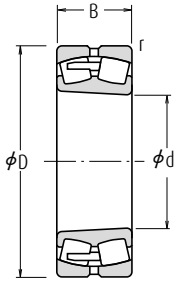
**Remarks**

1. The bearings denoted by an asterisk (*) are NSKHPS bearings and an oil groove and holes are standard for them.
2. When making a selection of the recommended fit (Tolerance of Shaft) on Page A164, in case of NSKHPS bearings, the conditions are different.
   The segmentations are: Light Loads ($\leqq 0.05C_r$); Normal Loads (0.05 to $0.10C_r$); and Heavy Loads ($>0.10C_r$).
3. For the dimensions of adapters and withdrawal sleeves, refer to Pages **B380 and B385.**

## Bore Diameter 140 – 150 mm




Cylindrical Bore
CA



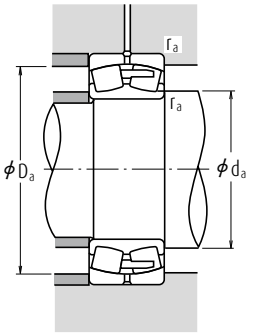

Tapered Bore
CA



Without an Oil Groove or Holes
CA

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Thermal Reference Speed | Speeds ($min^{-1}$) | | Bearing |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Limiting Speeds | | |
| d | D | B | r min. | $C_r$ | $C_{0r}$ | | Mechanical | Grease | Cylindrical Bore |
| **140** | 210 | 53 | 2 | 525 000 | 715 000 | 2 800 | 3 800 | 1 600 | **23028CAME4** * |
| | 210 | 53 | 2 | 420 000 | 715 000 | 2 400 | – | 1 600 | **23028CDE4** |
| | 210 | 69 | 2 | 635 000 | 905 000 | 2 200 | 3 000 | 1 300 | **24028CAME4** * |
| | 210 | 69 | 2 | 525 000 | 945 000 | 2 000 | – | 1 300 | **24028CE4** |
| | 225 | 68 | 2.1 | 725 000 | 945 000 | 2 400 | 3 200 | 1 200 | **23128CAME4** * |
| | 225 | 68 | 2.1 | 580 000 | 945 000 | 2 000 | – | 1 200 | **23128CE4** |
| | 225 | 85 | 2.1 | 835 000 | 1 160 000 | 1 600 | 2 600 | 1 200 | **24128CAME4** * |
| | 225 | 85 | 2.1 | 670 000 | 1 160 000 | 1 500 | – | 1 200 | **24128CE4** |
| | 250 | 68 | 3 | 835 000 | 945 000 | 2 600 | 3 200 | 1 400 | **22228CAME4** * |
| | 250 | 68 | 3 | 645 000 | 930 000 | 2 400 | – | 1 400 | **22228CDE4** |
| | 250 | 88 | 3 | 1 040 000 | 1 300 000 | 1 800 | 2 600 | 1 100 | **23228CAME4** * |
| | 250 | 88 | 3 | 835 000 | 1 300 000 | 1 600 | – | 1 100 | **23228CE4** |
| | 300 | 102 | 4 | 1 450 000 | 1 590 000 | 1 700 | 2 400 | 1 200 | **22328CAME4** * |
| | 300 | 102 | 4 | 1 160 000 | 1 590 000 | 1 700 | – | 1 200 | **22328CE4** |
| **150** | 225 | 56 | 2.1 | 590 000 | 815 000 | 2 600 | 3 600 | 1 400 | **23030CAME4** * |
| | 225 | 56 | 2.1 | 470 000 | 815 000 | 2 200 | – | 1 400 | **23030CDE4** |
| | 225 | 75 | 2.1 | 740 000 | 1 090 000 | 1 900 | 3 000 | 1 200 | **24030CAME4** * |
| | 225 | 75 | 2.1 | 590 000 | 1 090 000 | 1 800 | – | 1 200 | **24030CE4** |
| | 250 | 80 | 2.1 | 905 000 | 1 180 000 | 2 200 | 2 800 | 1 100 | **23130CAME4** * |
| | 250 | 80 | 2.1 | 725 000 | 1 180 000 | 1 800 | – | 1 100 | **23130CE4** |
| | 250 | 100 | 2.1 | 1 070 000 | 1 450 000 | 1 400 | 2 400 | 1 100 | **24130CAME4** * |
| | 250 | 100 | 2.1 | 890 000 | 1 530 000 | 1 300 | – | 1 100 | **24130CE4** |
| | 270 | 73 | 3 | 955 000 | 1 120 000 | 2 400 | 3 000 | 1 300 | **22230CAME4** * |
| | 270 | 73 | 3 | 765 000 | 1 120 000 | 2 200 | – | 1 300 | **22230CDE4** |
| | 270 | 96 | 3 | 1 220 000 | 1 560 000 | 1 700 | 2 400 | 1 100 | **23230CAME4** * |
| | 270 | 96 | 3 | 975 000 | 1 560 000 | 1 500 | – | 1 100 | **23230CE4** |
| | 320 | 108 | 4 | 1 530 000 | 1 690 000 | 1 600 | 2 200 | 1 100 | **22330CAME4** * |

**Note** (1) The suffix K or K30 represents bearings with tapered bores (taper 1 : 12 or 1 : 30).




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | $Y_3$ | 0.67 | $Y_2$ |

## Static Equivalent Load

$P_0=F_r+Y_0F_a$

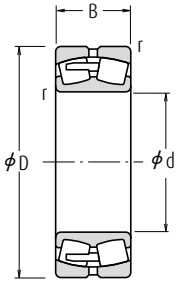
The values of e, $Y_2$ , $Y_3$ and $Y_0$ are given in the table below.

| Numbers | Abutment and Fillet Dimensions (mm) | | | | | Constant | Axial Load Factors | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $d_a$ | | $D_a$ | | $r_a$ | | | | | |
| Tapered Bore (1) | min. | max. | max. | min. | max. | e | $Y_2$ | $Y_3$ | $Y_0$ | approx. |
| **23028CAMKE4** * | 150 | 157 | 200 | 190 | 2 | 0.22 | 4.5 | 3.0 | 2.9 | 6.49 |
| **23028CDKE4** | 150 | 157 | 200 | 190 | 2 | 0.22 | 4.5 | 3.0 | 2.9 | 6.49 |
| **24028CAMK30E4** * | 150 | 154 | 200 | 186 | 2 | 0.31 | 3.4 | 2.3 | 2.2 | 8.37 |
| **24028CK30E4** | 150 | 154 | 200 | 186 | 2 | 0.29 | 3.4 | 2.3 | 2.2 | 8.37 |
| **23128CAMKE4** * | 152 | 158 | 213 | 198 | 2 | 0.28 | 3.6 | 2.4 | 2.3 | 10.5 |
| **23128CKE4** | 152 | 158 | 213 | 198 | 2 | 0.28 | 3.6 | 2.4 | 2.3 | 10.5 |
| **24128CAMK30E4** * | 152 | 156 | 213 | 193 | 2 | 0.37 | 2.7 | 1.8 | 1.8 | 13 |
| **24128CK30E4** | 152 | 156 | 213 | 193 | 2 | 0.35 | 2.9 | 1.9 | 1.9 | 13 |
| **22228CAMKE4** * | 154 | 167 | 236 | 221 | 2.5 | 0.26 | 3.9 | 2.6 | 2.5 | 14.5 |
| **22228CDKE4** | 154 | 167 | 236 | 219 | 2.5 | 0.25 | 4.0 | 2.7 | 2.6 | 14.5 |
| **23228CAMKE4** * | 154 | 163 | 236 | 213 | 2.5 | 0.35 | 2.9 | 1.9 | 1.9 | 18.8 |
| **23228CKE4** | 154 | 163 | 236 | 213 | 2.5 | 0.35 | 2.9 | 1.9 | 1.9 | 18.8 |
| **22328CAMKE4** * | 158 | 177 | 282 | 253 | 3 | 0.35 | 2.9 | 1.9 | 1.9 | 35.4 |
| **22328CKE4** | 158 | 177 | 282 | 253 | 3 | 0.35 | 2.9 | 1.9 | 1.9 | 35.4 |
| **23030CAMKE4** * | 162 | 168 | 213 | 203 | 2 | 0.22 | 4.6 | 3.1 | 3.0 | 7.9 |
| **23030CDKE4** | 162 | 168 | 213 | 203 | 2 | 0.22 | 4.6 | 3.1 | 3.0 | 7.9 |
| **24030CAMK30E4** * | 162 | 165 | 213 | 198 | 2 | 0.30 | 3.4 | 2.3 | 2.2 | 10.5 |
| **24030CK30E4** | 162 | 165 | 213 | 198 | 2 | 0.30 | 3.4 | 2.3 | 2.2 | 10.5 |
| **23130CAMKE4** * | 162 | 174 | 238 | 218 | 2 | 0.30 | 3.4 | 2.3 | 2.2 | 15.8 |
| **23130CKE4** | 162 | 174 | 238 | 218 | 2 | 0.30 | 3.4 | 2.3 | 2.2 | 15.8 |
| **24130CAMK30E4** * | 162 | 169 | 238 | 212 | 2 | 0.38 | 2.6 | 1.8 | 1.7 | 19.8 |
| **24130CK30E4** | 162 | 169 | 238 | 212 | 2 | 0.38 | 2.6 | 1.8 | 1.7 | 19.8 |
| **22230CAMKE4** * | 164 | 179 | 256 | 236 | 2.5 | 0.26 | 3.9 | 2.6 | 2.5 | 18.4 |
| **22230CDKE4** | 164 | 179 | 256 | 236 | 2.5 | 0.26 | 3.9 | 2.6 | 2.5 | 18.4 |
| **23230CAMKE4** * | 164 | 176 | 256 | 230 | 2.5 | 0.35 | 2.9 | 1.9 | 1.9 | 24.2 |
| **23230CKE4** | 164 | 176 | 256 | 230 | 2.5 | 0.35 | 2.9 | 1.9 | 1.9 | 24.2 |
| **22330CAMKE4** * | 164 | — | 302 | 270 | 3 | 0.35 | 2.9 | 1.9 | 1.9 | 41.5 |

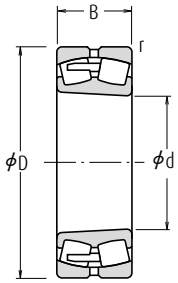
**Remarks**

1. The bearings denoted by an asterisk (*) are NSKHPS bearings and an oil groove and holes are standard for them.
2. When making a selection of the recommended fit (Tolerance of shaft) on Page A164, in case of NSKHPS bearings, the conditions are different.
   The segmentations are: Light Loads ($\leqq 0.05C_r$); Normal Loads (0.05 to $0.10C_r$); and Heavy Loads ($>0.10C_r$).
3. For the dimensions of adapters and withdrawal sleeves, refer to Pages **B380 and B386**.

## Bore Diameter 160 – 170 mm




Cylindrical Bore
CA



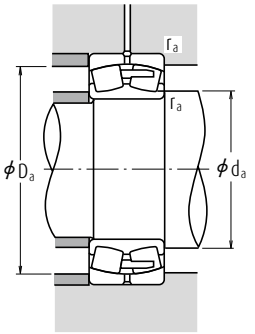

Tapered Bore
CA



Without an Oil Groove and Holes
CA

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Thermal Reference Speed | Speeds ($min^{-1}$) | | Bearing |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Limiting Speeds | | |
| d | D | B | r min. | $C_r$ | $C_{0r}$ | | Mechanical | Grease | Cylindrical Bore |
| **160** | 220 | 45 | 2 | 450 000 | 675 000 | 3 000 | 3 200 | 1 400 | **23932CAME4** * |
| | 220 | 45 | 2 | 360 000 | 675 000 | 3 000 | – | 1 400 | **23932CAE4** |
| | 240 | 60 | 2.1 | 675 000 | 955 000 | 2 400 | 3 200 | 1 300 | **23032CAME4** * |
| | 240 | 60 | 2.1 | 540 000 | 955 000 | 2 200 | – | 1 300 | **23032CDE4** |
| | 240 | 80 | 2.1 | 845 000 | 1 260 000 | 1 800 | 2 800 | 1 100 | **24032CAME4** * |
| | 240 | 80 | 2.1 | 680 000 | 1 260 000 | 1 700 | – | 1 100 | **24032CE4** |
| | 270 | 86 | 2.1 | 1 070 000 | 1 400 000 | 2 000 | 2 600 | 1 000 | **23132CAME4** * |
| | 270 | 86 | 2.1 | 855 000 | 1 400 000 | 1 700 | – | 1 000 | **23132CE4** |
| | 270 | 109 | 2.1 | 1 240 000 | 1 670 000 | 1 300 | 2 200 | 1 000 | **24132CAME4** * |
| | 270 | 109 | 2.1 | 1 040 000 | 1 760 000 | 1 200 | – | 1 000 | **24132CE4** |
| | 290 | 80 | 3 | 1 140 000 | 1 320 000 | 2 200 | 2 800 | 1 200 | **22232CAME4** * |
| | 290 | 80 | 3 | 910 000 | 1 320 000 | 2 000 | – | 1 200 | **22232CDE4** |
| | 290 | 104 | 3 | 1 370 000 | 1 770 000 | 1 500 | 2 200 | 1 000 | **23232CAME4** * |
| | 290 | 104 | 3 | 1 100 000 | 1 770 000 | 1 500 | – | 1 000 | **23232CE4** |
| | 340 | 114 | 4 | 1 700 000 | 1 900 000 | 1 400 | 2 200 | 1 100 | **22332CAME4** * |
| **170** | 230 | 45 | 2 | 450 000 | 680 000 | 3 000 | 3 600 | 1 400 | **23934CAME4** * |
| | 260 | 67 | 2.1 | 795 000 | 1 090 000 | 2 200 | 3 000 | 1 200 | **23034CAME4** * |
| | 260 | 67 | 2.1 | 640 000 | 1 090 000 | 2 000 | – | 1 200 | **23034CDE4** |
| | 260 | 90 | 2.1 | 1 030 000 | 1 520 000 | 1 600 | 2 400 | 1 000 | **24034CAME4** * |
| | 260 | 90 | 2.1 | 825 000 | 1 520 000 | 1 500 | – | 1 000 | **24034CE4** |
| | 280 | 88 | 2.1 | 1 180 000 | 1 570 000 | 1 800 | 2 600 | 1 000 | **23134CAME4** * |
| | 280 | 88 | 2.1 | 940 000 | 1 570 000 | 1 500 | – | 1 000 | **23134CE4** |
| | 280 | 109 | 2.1 | 1 280 000 | 1 770 000 | 1 200 | 2 200 | 1 000 | **24134CAME4** * |
| | 280 | 109 | 2.1 | 1 080 000 | 1 860 000 | 1 100 | – | 1 000 | **24134CE4** |
| | 310 | 86 | 4 | 1 240 000 | 1 500 000 | 2 000 | 2 600 | 1 100 | **22234CAME4** * |
| | 310 | 86 | 4 | 990 000 | 1 500 000 | 1 800 | – | 1 100 | **22234CDE4** |
| | 310 | 110 | 4 | 1 500 000 | 1 910 000 | 1 400 | 2 200 | 900 | **23234CAME4** * |
| | 310 | 110 | 4 | 1 200 000 | 1 910 000 | 1 300 | – | 900 | **23234CE4** |
| | 360 | 120 | 4 | 1 970 000 | 2 110 000 | 1 300 | 2 000 | 1 000 | **22334CAME4** * |

**Note** (1) The suffix K or K30 represents bearings with tapered bores (taper 1 : 12 or 1 : 30).




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | $Y_3$ | 0.67 | $Y_2$ |

## Static Equivalent Load

$P_0=F_r+Y_0F_a$

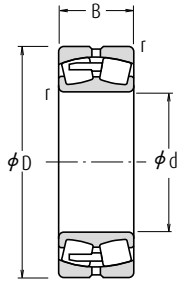
The values of e, $Y_2$ , $Y_3$ and $Y_0$ are given in the table below.

| Numbers | Abutment and Fillet Dimensions (mm) | | | | | Constant | Axial Load Factors | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $d_a$ | | $D_a$ | | $r_a$ | | | | | |
| Tapered Bore (1) | min. | max. | max. | min. | max. | e | $Y_2$ | $Y_3$ | $Y_0$ | approx. |
| **23932CAMKE4** * | 170 | — | 210 | 203 | 2 | 0.18 | 5.6 | 3.8 | 3.7 | 4.97 |
| **23932CAKE4** | 170 | — | 210 | 203 | 2 | 0.18 | 5.6 | 3.8 | 3.7 | 4.97 |
| **23032CAMKE4** * | 172 | 179 | 228 | 216 | 2 | 0.22 | 4.5 | 3.0 | 2.9 | 9.66 |
| **23032CDKE4** | 172 | 179 | 228 | 216 | 2 | 0.22 | 4.5 | 3.0 | 2.9 | 9.66 |
| **24032CAMK30E4** * | 172 | 177 | 228 | 212 | 2 | 0.30 | 3.4 | 2.3 | 2.2 | 12.7 |
| **24032CK30E4** | 172 | 177 | 228 | 212 | 2 | 0.30 | 3.4 | 2.3 | 2.2 | 12.7 |
| **23132CAMKE4** * | 172 | 185 | 258 | 234 | 2 | 0.30 | 3.4 | 2.3 | 2.2 | 20.3 |
| **23132CKE4** | 172 | 185 | 258 | 234 | 2 | 0.30 | 3.4 | 2.3 | 2.2 | 20.3 |
| **24132CAMK30E4** * | 172 | 179 | 258 | 229 | 2 | 0.39 | 2.6 | 1.7 | 1.7 | 25.4 |
| **24132CK30E4** | 172 | 179 | 258 | 229 | 2 | 0.39 | 2.6 | 1.7 | 1.7 | 25.4 |
| **22232CAMKE4** * | 174 | 190 | 276 | 255 | 2.5 | 0.26 | 3.8 | 2.6 | 2.5 | 23.1 |
| **22232CDKE4** | 174 | 190 | 276 | 255 | 2.5 | 0.26 | 3.8 | 2.6 | 2.5 | 23.1 |
| **23232CAMKE4** * | 174 | 189 | 276 | 245 | 2.5 | 0.34 | 2.9 | 2.0 | 1.9 | 30.5 |
| **23232CKE4** | 174 | 189 | 276 | 245 | 2.5 | 0.34 | 2.9 | 2.0 | 1.9 | 30.5 |
| **22332CAMKE4** * | 178 | — | 322 | 287 | 3 | 0.35 | 2.9 | 1.9 | 1.9 | 49.3 |
| **23934CAMKE4** * | 180 | — | 220 | 213 | 2 | 0.17 | 5.8 | 3.9 | 3.8 | 5.38 |
| **23034CAMKE4** * | 182 | 191 | 248 | 233 | 2 | 0.23 | 4.3 | 2.9 | 2.8 | 13 |
| **23034CDKE4** | 182 | 191 | 248 | 233 | 2 | 0.23 | 4.3 | 2.9 | 2.8 | 13 |
| **24034CAMK30E4** * | 182 | 188 | 248 | 228 | 2 | 0.31 | 3.2 | 2.2 | 2.1 | 17.3 |
| **24034CK30E4** | 182 | 188 | 248 | 228 | 2 | 0.31 | 3.2 | 2.2 | 2.1 | 17.3 |
| **23134CAMKE4** * | 182 | 194 | 268 | 245 | 2 | 0.29 | 3.5 | 2.3 | 2.3 | 21.8 |
| **23134CKE4** | 182 | 194 | 268 | 245 | 2 | 0.29 | 3.5 | 2.3 | 2.3 | 21.8 |
| **24134CAMK30E4** * | 182 | 190 | 268 | 239 | 2 | 0.38 | 2.7 | 1.8 | 1.7 | 26.6 |
| **24134CK30E4** | 182 | 190 | 268 | 239 | 2 | 0.37 | 2.7 | 1.8 | 1.8 | 26.6 |
| **22234CAMKE4** * | 188 | 206 | 292 | 270 | 3 | 0.26 | 3.8 | 2.6 | 2.5 | 28.8 |
| **22234CDKE4** | 188 | 206 | 292 | 270 | 3 | 0.26 | 3.8 | 2.6 | 2.5 | 28.8 |
| **23234CAMKE4** * | 188 | 201 | 292 | 261 | 3 | 0.35 | 2.9 | 1.9 | 1.9 | 36.4 |
| **23234CKE4** | 188 | 201 | 292 | 261 | 3 | 0.34 | 2.9 | 2.0 | 1.9 | 36.4 |
| **22334CAMKE4** * | 188 | — | 342 | 304 | 3 | 0.35 | 2.9 | 1.9 | 1.9 | 57.9 |

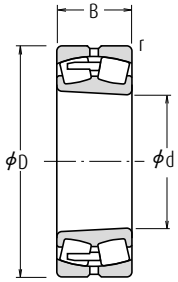
**Remarks**

1. The bearings denoted by an asterisk (*) are NSKHPS bearings and an oil groove and holes are standard for them.
2. When making a selection of the recommended fit (Tolerance of shaft) on Page A164, in case of NSKHPS bearings, the conditions are different.
   The segmentations are: Light Loads ($\leqq 0.05C_r$); Normal Loads (0.05 to $0.10C_r$); and Heavy Loads ($>0.10C_r$).
3. For the dimensions of adapters and withdrawal sleeves, refer to Pages **B380 and B386**.

## Bore Diameter 180 – 190 mm




Cylindrical Bore
CA



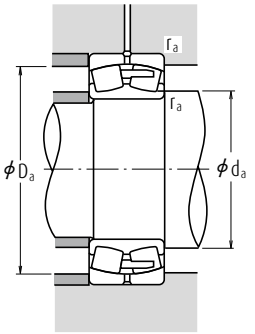

Tapered Bore
CA



Without an Oil Groove and Holes
CA

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Thermal Reference Speed | Speeds ($min^{-1}$) | | Bearing |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Limiting Speeds | | |
| d | D | B | r min. | $C_r$ | $C_{0r}$ | | Mechanical | Grease | Cylindrical Bore |
| **180** | 250 | 52 | 2 | 470 000 | 890 000 | 2 600 | – | 1 200 | **23936CAE4** |
| | 250 | 52 | 2 | 590 000 | 890 000 | 2 600 | 3 000 | 1 200 | **23936CAME4** * |
| | 280 | 74 | 2.1 | 935 000 | 1 270 000 | 2 000 | 2 800 | 1 200 | **23036CAME4** * |
| | 280 | 74 | 2.1 | 750 000 | 1 270 000 | 1 900 | – | 1 200 | **23036CDE4** |
| | 280 | 100 | 2.1 | 1 210 000 | 1 750 000 | 1 500 | 2 200 | 950 | **24036CAME4** * |
| | 280 | 100 | 2.1 | 965 000 | 1 750 000 | 1 400 | – | 950 | **24036CE4** |
| | 300 | 96 | 3 | 1 320 000 | 1 760 000 | 1 700 | 2 200 | 900 | **23136CAME4** * |
| | 300 | 96 | 3 | 1 050 000 | 1 760 000 | 1 400 | – | 900 | **23136CE4** |
| | 300 | 118 | 3 | 1 490 000 | 2 040 000 | 1 100 | 2 000 | 900 | **24136CAME4** * |
| | 300 | 118 | 3 | 1 190 000 | 2 040 000 | 1 000 | – | 900 | **24136CE4** |
| | 320 | 86 | 4 | 1 280 000 | 1 540 000 | 2 000 | 2 600 | 1 100 | **22236CAME4** * |
| | 320 | 86 | 4 | 1 020 000 | 1 540 000 | 1 800 | – | 1 100 | **22236CDE4** |
| | 320 | 112 | 4 | 1 620 000 | 2 110 000 | 1 300 | 2 000 | 850 | **23236CAME4** * |
| | 320 | 112 | 4 | 1 300 000 | 2 110 000 | 1 200 | – | 850 | **23236CE4** |
| | 380 | 126 | 4 | 2 170 000 | 2 340 000 | 1 200 | 2 000 | 950 | **22336CAME4** * |
| **190** | 260 | 52 | 2 | 575 000 | 875 000 | 2 600 | 3 000 | 1 200 | **23938CAME4** * |
| | 290 | 75 | 2.1 | 970 000 | 1 350 000 | 2 000 | 2 600 | 1 100 | **23038CAME4** * |
| | 290 | 100 | 2.1 | 1 220 000 | 1 840 000 | 1 400 | 2 200 | 900 | **24038CAME4** * |
| | 290 | 100 | 2.1 | 975 000 | 1 840 000 | 1 400 | – | 900 | **24038CE4** |
| | 320 | 104 | 3 | 1 480 000 | 2 020 000 | 1 600 | 2 200 | 850 | **23138CAME4** * |
| | 320 | 104 | 3 | 1 190 000 | 2 020 000 | 1 300 | – | 850 | **23138CE4** |
| | 320 | 128 | 3 | 1 710 000 | 2 330 000 | 1 000 | 1 900 | 850 | **24138CAME4** * |
| | 320 | 128 | 3 | 1 370 000 | 2 330 000 | 950 | – | 850 | **24138CE4** |
| | 340 | 92 | 4 | 1 420 000 | 1 730 000 | 1 800 | 2 400 | 1 000 | **22238CAME4** * |
| | 340 | 120 | 4 | 1 800 000 | 2 350 000 | 1 200 | 1 900 | 800 | **23238CAME4** * |
| | 340 | 120 | 4 | 1 440 000 | 2 350 000 | 1 100 | – | 800 | **23238CE4** |
| | 400 | 132 | 5 | 2 370 000 | 2 590 000 | 1 200 | 1 900 | 900 | **22338CAME4** * |

**Note** (1) The suffix K or K30 represents bearings with tapered bores (taper 1 : 12 or 1 : 30).




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | $Y_3$ | 0.67 | $Y_2$ |

## Static Equivalent Load

$P_0=F_r+Y_0F_a$

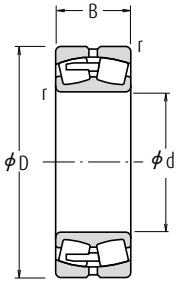
The values of e, $Y_2$ , $Y_3$ and $Y_0$ are given in the table below.

| Numbers | Abutment and Fillet Dimensions (mm) | | | | | Constant | Axial Load Factors | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $d_a$ | | $D_a$ | | $r_a$ | | | | | |
| Tapered Bore (1) | min. | max. | max. | min. | max. | e | $Y_2$ | $Y_3$ | $Y_0$ | approx. |
| **23936CAKE4** | 190 | — | 240 | 230 | 2 | 0.18 | 5.5 | 3.7 | 3.6 | 7.64 |
| **23936CAMKE4*** | 190 | — | 240 | 230 | 2 | 0.18 | 5.5 | 3.7 | 3.6 | 7.64 |
| **23036CAMKE4*** | 192 | 202 | 268 | 249 | 2 | 0.24 | 4.2 | 2.8 | 2.8 | 17.1 |
| **23036CDKE4** | 192 | 202 | 268 | 249 | 2 | 0.24 | 4.2 | 2.8 | 2.8 | 17.1 |
| **24036CAMK30E4*** | 192 | 200 | 268 | 245 | 2 | 0.32 | 3.1 | 2.1 | 2.0 | 22.7 |
| **24036CK30E4** | 192 | 200 | 268 | 245 | 2 | 0.32 | 3.1 | 2.1 | 2.0 | 22.7 |
| **23136CAMKE4*** | 194 | 206 | 286 | 260 | 2.5 | 0.31 | 3.3 | 2.2 | 2.2 | 27.5 |
| **23136CKE4** | 194 | 206 | 286 | 260 | 2.5 | 0.30 | 3.4 | 2.3 | 2.2 | 27.5 |
| **24136CAMK30E4*** | 194 | 202 | 286 | 255 | 2.5 | 0.37 | 2.7 | 1.8 | 1.8 | 33.1 |
| **24136CK30E4** | 194 | 202 | 286 | 255 | 2.5 | 0.37 | 2.7 | 1.8 | 1.8 | 33.1 |
| **22236CAMKE4*** | 198 | 212 | 302 | 278 | 3 | 0.26 | 3.9 | 2.6 | 2.6 | 30.2 |
| **22236CDKE4** | 198 | 212 | 302 | 278 | 3 | 0.26 | 3.9 | 2.6 | 2.6 | 30.2 |
| **23236CAMKE4*** | 198 | 211 | 302 | 274 | 3 | 0.35 | 2.9 | 1.9 | 1.9 | 38.9 |
| **23236CKE4** | 198 | 211 | 302 | 274 | 3 | 0.33 | 3.0 | 2.0 | 2.0 | 38.9 |
| **22336CAMKE4*** | 198 | — | 362 | 322 | 3 | 0.34 | 2.9 | 2.0 | 1.9 | 67 |
| **23938CAMKE4*** | 200 | — | 250 | 240 | 2 | 0.18 | 5.7 | 3.8 | 3.7 | 8.03 |
| **23038CAMKE4*** | 202 | — | 278 | 261 | 2 | 0.24 | 4.2 | 2.8 | 2.8 | 17.6 |
| **24038CAMK30E4*** | 202 | 210 | 278 | 253 | 2 | 0.32 | 3.1 | 2.1 | 2.0 | 24 |
| **24038CK30E4** | 202 | 210 | 278 | 253 | 2 | 0.31 | 3.2 | 2.2 | 2.1 | 24 |
| **23138CAMKE4*** | 204 | 219 | 306 | 276 | 2.5 | 0.31 | 3.2 | 2.2 | 2.1 | 34.5 |
| **23138CKE4** | 204 | 219 | 306 | 276 | 2.5 | 0.31 | 3.3 | 2.2 | 2.2 | 34.5 |
| **24138CAMK30E4*** | 204 | 211 | 306 | 269 | 2.5 | 0.40 | 2.5 | 1.7 | 1.6 | 41.5 |
| **24138CK30E4** | 204 | 211 | 306 | 269 | 2.5 | 0.40 | 2.5 | 1.7 | 1.6 | 41.5 |
| **22238CAMKE4*** | 208 | — | 322 | 296 | 3 | 0.26 | 3.8 | 2.6 | 2.5 | 35.5 |
| **23238CAMKE4*** | 208 | 222 | 322 | 288 | 3 | 0.35 | 2.8 | 1.9 | 1.9 | 47.6 |
| **23238CKE4** | 208 | 222 | 322 | 288 | 3 | 0.35 | 2.9 | 1.9 | 1.9 | 47.6 |
| **22338CAMKE4*** | 212 | — | 378 | 338 | 4 | 0.34 | 2.9 | 2.0 | 1.9 | 77.6 |

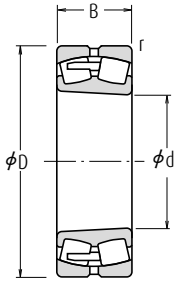
**Remarks**

1. The bearings denoted by an asterisk (*) are NSKHPS bearings and an oil groove and holes are standard for them.
2. When making a selection of the recommended fit (Tolerance of shaft) on Page A164, in case of NSKHPS bearings, the conditions are different.
   The segmentations are: Light Loads ($\leqq 0.05C_r$); Normal Loads (0.05 to $0.10C_r$); and Heavy Loads ($>0.10C_r$).
3. For the dimensions of adapters and withdrawal sleeves, refer to Pages **B381, and B386 – B387**.

## Bore Diameter 200 – 220 mm




Cylindrical Bore
CA



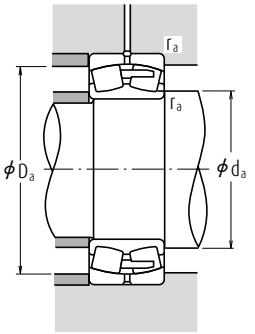

Tapered Bore
CA



Without an Oil Groove and Holes
CA

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Thermal Reference Speed | Speeds ($min^{-1}$) | | Bearing |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Limiting Speeds | | |
| d | D | B | r min. | $C_r$ | $C_{0r}$ | | Mechanical | Grease | Cylindrical Bore |
| **200** | 280 | 60 | 2.1 | 570 000 | 1 060 000 | – | – | – | **23940CAE4** |
| | 280 | 60 | 2.1 | 710 000 | 1 060 000 | 2 400 | 2 600 | 1 100 | **23940CAME4** * |
| | 310 | 82 | 2.1 | 1 180 000 | 1 700 000 | 1 800 | 2 400 | 1 000 | **23040CAME4** * |
| | 310 | 109 | 2.1 | 1 420 000 | 2 120 000 | 1 300 | 2 000 | 850 | **24040CAME4** * |
| | 310 | 109 | 2.1 | 1 140 000 | 2 120 000 | 1 300 | – | 850 | **24040CE4** |
| | 340 | 112 | 3 | 1 700 000 | 2 330 000 | 1 500 | 2 000 | 800 | **23140CAME4** * |
| | 340 | 112 | 3 | 1 360 000 | 2 330 000 | 1 200 | – | 800 | **23140CE4** |
| | 340 | 140 | 3 | 1 960 000 | 2 660 000 | 950 | 1 800 | 800 | **24140CAME4** * |
| | 340 | 140 | 3 | 1 570 000 | 2 670 000 | 900 | – | 800 | **24140CE4** |
| | 360 | 98 | 4 | 1 620 000 | 2 010 000 | 1 700 | 2 200 | 950 | **22240CAME4** * |
| | 360 | 128 | 4 | 2 070 000 | 2 750 000 | 1 100 | 1 800 | 750 | **23240CAME4** * |
| | 360 | 128 | 4 | 1 660 000 | 2 750 000 | 1 000 | – | 750 | **23240CE4** |
| | 420 | 138 | 5 | 2 500 000 | 2 990 000 | 1 100 | 1 700 | 850 | **22340CAME4** * |
| **220** | 300 | 60 | 2.1 | 785 000 | 1 240 000 | 2 200 | 2 600 | 1 000 | **23944CAME4** * |
| | 340 | 90 | 3 | 1 360 000 | 1 980 000 | 1 600 | 2 200 | 950 | **23044CAME4** * |
| | 340 | 118 | 3 | 1 640 000 | 2 490 000 | 1 200 | 1 900 | 750 | **24044CAME4** * |
| | 340 | 118 | 3 | 1 360 000 | 2 600 000 | 1 100 | – | 750 | **24044CE4** |
| | 370 | 120 | 4 | 1 960 000 | 2 710 000 | 1 300 | 1 800 | 710 | **23144CAME4** * |
| | 370 | 120 | 4 | 1 570 000 | 2 710 000 | 1 100 | – | 710 | **23144CE4** |
| | 370 | 150 | 4 | 2 250 000 | 3 200 000 | 850 | 1 600 | 710 | **24144CAME4** * |
| | 370 | 150 | 4 | 1 800 000 | 3 200 000 | 850 | – | 710 | **24144CE4** |
| | 400 | 108 | 4 | 1 960 000 | 2 430 000 | 1 500 | 2 000 | 850 | **22244CAME4** * |
| | 400 | 144 | 4 | 2 520 000 | 3 400 000 | 1 000 | 1 600 | 670 | **23244CAME4** * |
| | 400 | 144 | 4 | 2 020 000 | 3 400 000 | 850 | – | 670 | **23244CE4** |
| | 460 | 145 | 5 | 2 940 000 | 3 400 000 | 950 | 1 600 | 750 | **22344CAME4** * |

**Note** (1) The suffix K or K30 represents bearings with tapered bores (taper 1 : 12 or 1 : 30).




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | $Y_3$ | 0.67 | $Y_2$ |

## Static Equivalent Load

$P_0=F_r+Y_0F_a$

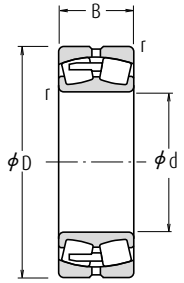
The values of e, $Y_2$ , $Y_3$ and $Y_0$ are given in the table below.

| Numbers | Abutment and Fillet Dimensions (mm) | | | | | Constant | Axial Load Factors | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $d_a$ | | $D_a$ | | $r_a$ | | | | | |
| Tapered Bore (1) | min. | max. | max. | min. | max. | e | $Y_2$ | $Y_3$ | $Y_0$ | approx. |
| **23940CAKE4** | 212 | — | 268 | 258 | 2 | 0.20 | 5.1 | 3.4 | 3.3 | 11 |
| **23940CAMKE4*** | 212 | — | 268 | 258 | 2 | 0.20 | 5.1 | 3.4 | 3.3 | 11 |
| **23040CAMKE4*** | 212 | — | 268 | 279 | 2 | 0.25 | 4.0 | 2.7 | 2.6 | 22.6 |
| **24040CAMK30E4*** | 212 | 223 | 298 | 271 | 2 | 0.33 | 3.0 | 2.0 | 2.0 | 30.4 |
| **24040CK30E4** | 212 | 223 | 298 | 271 | 2 | 0.32 | 3.1 | 2.1 | 2.0 | 30.4 |
| **23140CAMKE4*** | 214 | 232 | 326 | 293 | 2.5 | 0.30 | 3.2 | 2.1 | 2.1 | 42.7 |
| **23140CKE4** | 214 | 232 | 326 | 293 | 2.5 | 0.31 | 3.2 | 2.2 | 2.1 | 42.7 |
| **24140CAMK30E4*** | 214 | 226 | 326 | 290 | 2.5 | 0.39 | 2.5 | 1.7 | 1.7 | 51.3 |
| **24140CK30E4** | 214 | 226 | 326 | 290 | 2.5 | 0.39 | 2.6 | 1.8 | 1.7 | 51.3 |
| **22240CAMKE4*** | 218 | — | 342 | 315 | 3 | 0.26 | 3.8 | 2.6 | 2.5 | 42.6 |
| **23240CAMKE4*** | 218 | 237 | 342 | 307 | 3 | 0.35 | 2.9 | 1.9 | 1.9 | 57.1 |
| **23240CKE4** | 222 | 237 | 342 | 307 | 3 | 0.34 | 2.9 | 2.0 | 1.9 | 57.1 |
| **22340CAMKE4*** | 232 | — | 398 | 352 | 4 | 0.34 | 2.9 | 2.0 | 1.9 | 92.6 |
| **23944CAMKE4*** | 234 | — | 288 | 278 | 2 | 0.18 | 5.7 | 3.8 | 3.7 | 12.2 |
| **23044CAMKE4*** | 234 | — | 326 | 302 | 2.5 | 0.24 | 4.1 | 2.8 | 2.7 | 29.7 |
| **24044CAMK30E4*** | 234 | 244 | 326 | 296 | 2.5 | 0.32 | 3.2 | 2.1 | 2.1 | 40.5 |
| **24044CK30E4** | 238 | 244 | 326 | 296 | 2.5 | 0.31 | 3.2 | 2.1 | 2.1 | 40.5 |
| **23144CAMKE4*** | 238 | 254 | 352 | 320 | 3 | 0.31 | 3.3 | 2.2 | 2.2 | 53 |
| **23144CKE4** | 238 | 254 | 352 | 320 | 3 | 0.30 | 3.3 | 2.2 | 2.2 | 53 |
| **24144CAMK30E4*** | 238 | — | 352 | 313 | 3 | 0.39 | 2.6 | 1.7 | 1.7 | 66.7 |
| **24144CK30E4** | 238 | 248 | 352 | 313 | 3 | 0.39 | 2.6 | 1.7 | 1.7 | 66.7 |
| **22244CAMKE4*** | 238 | — | 382 | 348 | 3 | 0.27 | 3.7 | 2.5 | 2.4 | 59 |
| **23244CAMKE4*** | 238 | 260 | 382 | 337 | 3 | 0.36 | 2.8 | 1.9 | 1.8 | 80.4 |
| **23244CKE4** | 238 | 260 | 382 | 337 | 3 | 0.35 | 2.9 | 1.9 | 1.9 | 80.4 |
| **22344CAMKE4*** | 242 | — | 438 | 391 | 4 | 0.33 | 3.0 | 2.0 | 2.0 | 116 |

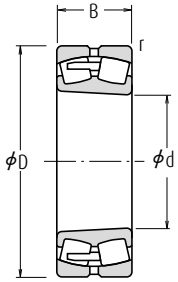
**Remarks**

1. The bearings denoted by an asterisk (*) are NSKHPS bearings and an oil groove and holes are standard for them.
2. When making a selection of the recommended fit (Tolerance of shaft) on Page A164, in case of NSKHPS bearings, the conditions are different.
   The segmentations are: Light Loads ($\leqq 0.05C_r$); Normal Loads (0.05 to $0.10C_r$); and Heavy Loads ($>0.10C_r$).
3. For the dimensions of adapters and withdrawal sleeves, refer to Pages **B381 and B387**.

## Bore Diameter 240 – 280 mm




Cylindrical Bore
CA



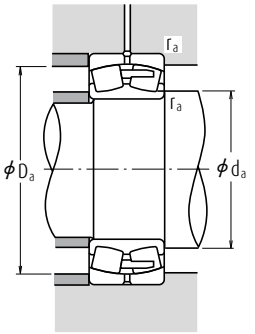

Tapered Bore
CA



Without an Oil Groove and Holes
CA

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Thermal Reference Speed | Speeds ($min^{-1}$) | | Bearing |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Limiting Speeds | | |
| d | D | B | r min. | $C_r$ | $C_{0r}$ | | Mechanical | Grease | Cylindrical Bore |
| **240** | 320 | 60 | 2.1 | 635 000 | 1 300 000 | 1 900 | 2 600 | 950 | **23948CAE4** |
| | 320 | 60 | 2.1 | 795 000 | 1 300 000 | 1 900 | 2 600 | 950 | **23948CAME4**[*] |
| | 360 | 92 | 3 | 1 450 000 | 2 140 000 | 1 500 | 2 200 | 850 | **23048CAME4**[*] |
| | 360 | 118 | 3 | 1 730 000 | 2 730 000 | 1 100 | 1 800 | 710 | **24048CAME4**[*] |
| | 360 | 118 | 3 | 1 390 000 | 2 730 000 | 1 000 | – | 710 | **24048CE4** |
| | 400 | 128 | 4 | 2 230 000 | 3 100 000 | 1 200 | 1 700 | 670 | **23148CAME4**[*] |
| | 400 | 128 | 4 | 1 790 000 | 3 100 000 | 1 000 | – | 670 | **23148CE4** |
| | 400 | 160 | 4 | 2 660 000 | 3 800 000 | 750 | 1 500 | 670 | **24148CAME4**[*] |
| | 400 | 160 | 4 | 2 130 000 | 3 800 000 | 670 | – | 670 | **24148CE4** |
| | 440 | 120 | 4 | 2 340 000 | 2 890 000 | 1 400 | 1 800 | 750 | **22248CAME4**[*] |
| | 440 | 160 | 4 | 3 050 000 | 4 050 000 | 850 | 1 500 | 630 | **23248CAME4**[*] |
| | 500 | 155 | 5 | 3 250 000 | 3 800 000 | 850 | 1 500 | 670 | **22348CAME4**[*] |
| **260** | 360 | 75 | 2.1 | 1 170 000 | 1 870 000 | 1 800 | 2 200 | 850 | **23952CAME4**[*] |
| | 400 | 104 | 4 | 1 780 000 | 2 580 000 | 1 300 | 1 900 | 800 | **23052CAME4**[*] |
| | 400 | 140 | 4 | 2 270 000 | 3 500 000 | 950 | 1 600 | 630 | **24052CAME4**[*] |
| | 440 | 144 | 4 | 2 700 000 | 3 750 000 | 1 100 | 1 500 | 600 | **23152CAME4**[*] |
| | 440 | 180 | 4 | 3 200 000 | 4 700 000 | 630 | 1 300 | 600 | **24152CAME4**[*] |
| | 480 | 130 | 5 | 2 720 000 | 3 400 000 | 1 200 | 1 700 | 670 | **22252CAME4**[*] |
| | 480 | 174 | 5 | 3 400 000 | 4 550 000 | 800 | 1 400 | 560 | **23252CAME4**[*] |
| | 540 | 165 | 6 | 3 900 000 | 4 600 000 | 750 | 1 400 | 630 | **22352CAME4**[*] |
| **280** | 380 | 75 | 2.1 | 1 160 000 | 1 950 000 | 1 600 | 2 000 | 800 | **23956CAME4**[*] |
| | 420 | 106 | 4 | 1 930 000 | 2 950 000 | 1 200 | 1 800 | 710 | **23056CAME4**[*] |
| | 420 | 140 | 4 | 2 350 000 | 3 800 000 | 850 | 1 500 | 600 | **24056CAME4**[*] |
| | 460 | 146 | 5 | 2 790 000 | 4 000 000 | 1 000 | 1 500 | 560 | **23156CAME4**[*] |
| | 460 | 180 | 5 | 3 300 000 | 5 000 000 | 600 | 1 300 | 560 | **24156CAME4**[*] |
| | 500 | 130 | 5 | 2 850 000 | 3 650 000 | 1 100 | 1 600 | 630 | **22256CAME4**[*] |
| | 500 | 176 | 5 | 3 600 000 | 4 900 000 | 750 | 1 300 | 530 | **23256CAME4**[*] |
| | 580 | 175 | 6 | 4 350 000 | 5 150 000 | 670 | 1 300 | 560 | **22356CAME4**[*] |

**Note** (1) The suffix K or K30 represents bearings with tapered bores (taper 1 : 12 or 1 : 30).




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | $Y_3$ | 0.67 | $Y_2$ |

## Static Equivalent Load

$P_0=F_r+Y_0F_a$

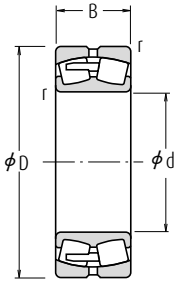
The values of e, $Y_2$ , $Y_3$ and $Y_0$ are given in the table below.

| Numbers | Abutment and Fillet Dimensions (mm) | | | | | Constant | Axial Load Factors | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $d_a$ | | $D_a$ | | $r_a$ | | | | | |
| Tapered Bore (1) | min. | max. | max. | min. | max. | e | $Y_2$ | $Y_3$ | $Y_0$ | approx. |
| **23948CAKE4** | 252 | — | 308 | 298 | 2 | 0.17 | 6.0 | 4.0 | 3.9 | 13.3 |
| **23948CAMKE4*** | 253 | — | 308 | 298 | 2 | 0.18 | 6.1 | 4.1 | 3.10 | 13.4 |
| **23048CAMKE4*** | 254 | — | 346 | 324 | 2.5 | 0.24 | 4.2 | 2.8 | 2.7 | 32.6 |
| **24048CAMK30E4*** | 254 | 265 | 346 | 317 | 2.5 | 0.30 | 3.4 | 2.3 | 2.2 | 43.4 |
| **24048CK30E4** | 254 | 265 | 346 | 317 | 2.5 | 0.29 | 3.4 | 2.3 | 2.2 | 43.4 |
| **23148CAMKE4*** | 258 | 275 | 382 | 347 | 3 | 0.31 | 3.3 | 2.2 | 2.2 | 66.9 |
| **23148CKE4** | 258 | 275 | 382 | 347 | 3 | 0.30 | 3.3 | 2.2 | 2.2 | 66.9 |
| **24148CAMK30E4*** | 258 | 268 | 382 | 341 | 3 | 0.38 | 2.7 | 1.8 | 1.8 | 79.5 |
| **24148CK30E4** | 258 | 268 | 382 | 341 | 3 | 0.38 | 2.7 | 1.8 | 1.8 | 79.5 |
| **22248CAMKE4*** | 258 | — | 422 | 383 | 3 | 0.27 | 3.7 | 2.5 | 2.4 | 80.2 |
| **23248CAMKE4*** | 258 | — | 422 | 372 | 3 | 0.37 | 2.7 | 1.8 | 1.8 | 106 |
| **22348CAMKE4*** | 262 | — | 478 | 423 | 4 | 0.32 | 3.2 | 2.1 | 2.1 | 147 |
| **23952CAMKE4*** | 272 | — | 348 | 333 | 2 | 0.19 | 5.4 | 3.6 | 3.5 | 23 |
| **23052CAMKE4*** | 278 | — | 382 | 356 | 3 | 0.25 | 4.1 | 2.7 | 2.7 | 46.6 |
| **24052CAMK30E4*** | 278 | — | 382 | 348 | 3 | 0.32 | 3.1 | 2.1 | 2.1 | 62.6 |
| **23152CAMKE4*** | 278 | — | 422 | 380 | 3 | 0.32 | 3.2 | 2.1 | 2.1 | 88.2 |
| **24152CAMK30E4*** | 278 | — | 422 | 371 | 3 | 0.39 | 2.6 | 1.7 | 1.7 | 109 |
| **22252CAMKE4*** | 282 | — | 458 | 418 | 4 | 0.27 | 3.7 | 2.5 | 2.5 | 104 |
| **23252CAMKE4*** | 282 | — | 458 | 406 | 4 | 0.37 | 2.7 | 1.8 | 1.8 | 137 |
| **22352CAMKE4*** | 288 | — | 512 | 462 | 5 | 0.32 | 3.2 | 2.1 | 2.1 | 180 |
| **23956CAMKE4*** | 292 | — | 368 | 351 | 2 | 0.18 | 5.7 | 3.8 | 3.8 | 24.5 |
| **23056CAMKE4*** | 298 | — | 402 | 377 | 3 | 0.24 | 4.2 | 2.8 | 2.7 | 50.5 |
| **24056CAMK30E4*** | 298 | — | 402 | 369 | 3 | 0.31 | 3.3 | 2.2 | 2.2 | 66.4 |
| **23156CAMKE4*** | 302 | — | 438 | 400 | 4 | 0.30 | 3.3 | 2.2 | 2.2 | 94.3 |
| **24156CAMK30E4*** | 302 | — | 438 | 392 | 4 | 0.37 | 2.7 | 1.8 | 1.8 | 115 |
| **22256CAMKE4*** | 302 | — | 478 | 439 | 4 | 0.25 | 4.0 | 2.7 | 2.6 | 110 |
| **23256CAMKE4*** | 302 | — | 478 | 425 | 4 | 0.35 | 2.9 | 1.9 | 1.9 | 147 |
| **22356CAMKE4*** | 308 | — | 552 | 496 | 5 | 0.31 | 3.2 | 2.1 | 2.1 | 221 |

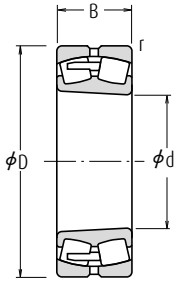
**Remarks**

1. The bearings denoted by an asterisk (*) are NSKHPS bearings and an oil groove and holes are standard for them.
2. When making a selection of the recommended fit (Tolerance of shaft) on Page A164, in case of NSKHPS bearings, the conditions are different.
   The segmentations are: Light Loads ($\leqq 0.05C_r$); Normal Loads (0.05 to $0.10C_r$); and Heavy Loads ($>0.10C_r$).
3. For the dimensions of adapters and withdrawal sleeves, refer to Pages **B381, B382 and B387 – B388**.

## Bore Diameter 300 – 380 mm




Cylindrical Bore
CA



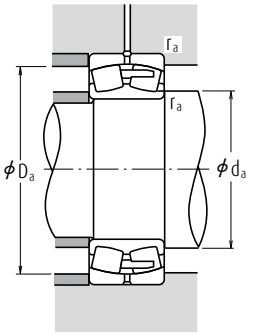

Tapered Bore
CA



Without an Oil Groove and Holes
CA

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Thermal Reference Speed | Speeds ($min^{-1}$) | | Bearing |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Limiting Speeds | | |
| d | D | B | r min. | $C_r$ | $C_{0r}$ | | Mechanical | Grease | Cylindrical Bore |
| **300** | 420 | 90 | 3 | 1 540 000 | 2 490 000 | 1 500 | 1 800 | 710 | **23960CAME4*** |
| | 460 | 118 | 4 | 2 400 000 | 3 700 000 | 1 100 | 1 600 | 670 | **23060CAME4*** |
| | 460 | 160 | 4 | 2 890 000 | 4 600 000 | 800 | 1 400 | 530 | **24060CAME4*** |
| | 500 | 160 | 5 | 3 350 000 | 4 800 000 | 900 | 1 400 | 500 | **23160CAME4*** |
| | 500 | 200 | 5 | 3 900 000 | 5 800 000 | 530 | 1 200 | 500 | **24160CAME4*** |
| | 540 | 140 | 5 | 3 250 000 | 4 250 000 | 1 000 | 1 500 | 600 | **22260CAME4*** |
| | 540 | 192 | 5 | 4 250 000 | 5 900 000 | 670 | 1 200 | 480 | **23260CAME4*** |
| **320** | 440 | 90 | 3 | 1 620 000 | 2 750 000 | 1 400 | 1 700 | 670 | **23964CAME4*** |
| | 480 | 121 | 4 | 2 450 000 | 3 850 000 | 1 000 | 1 600 | 630 | **23064CAME4*** |
| | 480 | 160 | 4 | 3 050 000 | 5 050 000 | 710 | 1 300 | 500 | **24064CAME4*** |
| | 540 | 176 | 5 | 3 850 000 | 5 500 000 | 800 | 1 300 | 480 | **23164CAME4*** |
| | 540 | 218 | 5 | 4 400 000 | 6 650 000 | 480 | 1 100 | 480 | **24164CAME4*** |
| | 580 | 150 | 5 | 3 750 000 | 4 850 000 | 950 | 1 400 | 530 | **22264CAME4*** |
| | 580 | 208 | 5 | 4 850 000 | 6 900 000 | 600 | 1 100 | 450 | **23264CAME4*** |
| **340** | 460 | 90 | 3 | 1 670 000 | 2 840 000 | 1 300 | 1 700 | 630 | **23968CAME4*** |
| | 520 | 133 | 5 | 2 850 000 | 4 400 000 | 950 | 1 500 | 560 | **23068CAME4*** |
| | 520 | 180 | 5 | 3 650 000 | 6 050 000 | 670 | 1 200 | 480 | **24068CAME4*** |
| | 580 | 190 | 5 | 4 500 000 | 6 600 000 | 710 | 1 200 | 430 | **23168CAME4*** |
| | 580 | 243 | 5 | 5 300 000 | 7 900 000 | 450 | 1 000 | 430 | **24168CAME4*** |
| | 620 | 224 | 6 | 4 400 000 | 7 800 000 | 480 | – | 400 | **23268CAME4** |
| **360** | 480 | 90 | 3 | 1 730 000 | 3 050 000 | 1 200 | 1 700 | 600 | **23972CAME4*** |
| | 540 | 134 | 5 | 2 990 000 | 4 700 000 | 900 | 1 400 | 530 | **23072CAME4*** |
| | 540 | 180 | 5 | 3 650 000 | 6 100 000 | 630 | 1 200 | 450 | **24072CAME4*** |
| | 600 | 192 | 5 | 4 800 000 | 7 100 000 | 670 | 1 100 | 400 | **23172CAME4*** |
| | 600 | 243 | 5 | 5 250 000 | 8 000 000 | 430 | 1 000 | 400 | **24172CAME4*** |
| | 600 | 232 | 6 | 4 800 000 | 8 550 000 | 450 | – | 380 | **23272CAME4** |
| **380** | 520 | 106 | 4 | 2 340 000 | 4 100 000 | 1 100 | 1 500 | 530 | **23976CAME4*** |
| | 560 | 135 | 5 | 3 150 000 | 5 100 000 | 850 | 1 400 | 530 | **23076CAME4*** |
| | 560 | 180 | 5 | 3 850 000 | 6 600 000 | 600 | 1 200 | 430 | **24076CAME4*** |
| | 620 | 194 | 5 | 4 000 000 | 7 600 000 | 530 | – | 400 | **23176CAME4** |
| | 620 | 243 | 5 | 4 350 000 | 8 450 000 | 360 | – | 400 | **24176CAME4** |
| | 680 | 240 | 6 | 5 150 000 | 9 200 000 | 430 | – | 360 | **23276CAME4** |

**Note** (1) The suffix K or K30 represents bearings with tapered bores (taper 1 : 12 or 1 : 30).




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | $Y_3$ | 0.67 | $Y_2$ |

## Static Equivalent Load

$P_0=F_r+Y_0F_a$

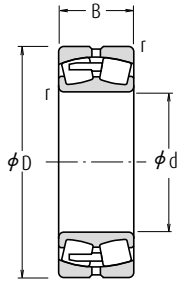
The values of e, $Y_2$ , $Y_3$ and $Y_0$ are given in the table below.

| Numbers | Abutment and Fillet Dimensions (mm) | | | | | Constant | Axial Load Factors | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $d_a$ | | $D_a$ | | $r_a$ | | | | | |
| Tapered Bore (1) | min. | max. | max. | min. | max. | e | $Y_2$ | $Y_3$ | $Y_0$ | approx. |
| **23960CAMKE4*** | 314 | — | 406 | 386 | 2.5 | 0.19 | 5.2 | 3.5 | 3.4 | 38.2 |
| **23060CAMKE4*** | 318 | — | 442 | 413 | 3 | 0.24 | 4.2 | 2.8 | 2.7 | 70.5 |
| **24060CAMK30E4*** | 318 | — | 442 | 400 | 3 | 0.32 | 3.1 | 2.1 | 2.0 | 93.6 |
| **23160CAMKE4*** | 322 | — | 478 | 433 | 4 | 0.31 | 3.3 | 2.2 | 2.2 | 125 |
| **24160CAMK30E4*** | 322 | — | 478 | 423 | 4 | 0.38 | 2.6 | 1.8 | 1.7 | 152 |
| **22260CAMKE4*** | 322 | — | 518 | 473 | 4 | 0.25 | 4.0 | 2.7 | 2.6 | 139 |
| **23260CAMKE4*** | 322 | — | 518 | 458 | 4 | 0.35 | 2.9 | 1.9 | 1.9 | 189 |
| **23964CAMKE4*** | 334 | — | 426 | 406 | 2.5 | 0.18 | 5.5 | 3.7 | 3.6 | 40.6 |
| **23064CAMKE4*** | 338 | — | 462 | 432 | 3 | 0.24 | 4.2 | 2.8 | 2.8 | 75.6 |
| **24064CAMK30E4*** | 338 | — | 462 | 422 | 3 | 0.31 | 3.3 | 2.2 | 2.2 | 99.7 |
| **23164CAMKE4*** | 342 | — | 518 | 466 | 4 | 0.31 | 3.2 | 2.1 | 2.1 | 162 |
| **24164CAMK30E4*** | 342 | — | 518 | 456 | 4 | 0.39 | 2.6 | 1.7 | 1.7 | 196 |
| **22264CAMKE4*** | 342 | — | 558 | 508 | 4 | 0.26 | 3.9 | 2.6 | 2.6 | 174 |
| **23264CAMKE4*** | 342 | — | 558 | 488 | 4 | 0.36 | 2.8 | 1.9 | 1.8 | 239 |
| **23968CAMKE4*** | 354 | — | 446 | 427 | 2.5 | 0.18 | 5.7 | 3.8 | 3.7 | 42.4 |
| **23068CAMKE4*** | 362 | — | 498 | 465 | 4 | 0.24 | 4.2 | 2.8 | 2.8 | 101 |
| **24068CAMK30E4*** | 362 | — | 498 | 454 | 4 | 0.32 | 3.2 | 2.1 | 2.1 | 135 |
| **23168CAMKE4*** | 362 | — | 558 | 499 | 4 | 0.31 | 3.2 | 2.1 | 2.1 | 206 |
| **24168CAMK30E4*** | 362 | — | 558 | 489 | 4 | 0.40 | 2.5 | 1.7 | 1.7 | 257 |
| **23268CAMKE4** | 368 | — | 592 | 521 | 5 | 0.36 | 2.8 | 1.9 | 1.8 | 295 |
| **23972CAMKE4*** | 374 | — | 466 | 447 | 2.5 | 0.17 | 6.0 | 4.1 | 4.0 | 44.7 |
| **23072CAMKE4*** | 382 | — | 518 | 485 | 4 | 0.24 | 4.2 | 2.8 | 2.8 | 106 |
| **24072CAMK30E4*** | 382 | — | 518 | 476 | 4 | 0.32 | 3.2 | 2.1 | 2.1 | 139 |
| **23172CAMKE4*** | 382 | — | 578 | 520 | 4 | 0.31 | 3.2 | 2.2 | 2.1 | 217 |
| **24172CAMK30E4*** | 382 | — | 578 | 507 | 4 | 0.40 | 2.5 | 1.7 | 1.7 | 264 |
| **23272CAMKE4** | 388 | — | 622 | 549 | 5 | 0.36 | 2.8 | 1.9 | 1.8 | 342 |
| **23976CAMKE4*** | 398 | — | 502 | 482 | 3 | 0.18 | 5.5 | 3.7 | 3.6 | 65.4 |
| **23076CAMKE4*** | 402 | — | 538 | 506 | 4 | 0.22 | 4.5 | 3.0 | 3.0 | 113 |
| **24076CAMK30E4*** | 402 | — | 538 | 496 | 4 | 0.29 | 3.4 | 2.3 | 2.3 | 148 |
| **23176CAMKE4** | 402 | — | 598 | 540 | 4 | 0.30 | 3.3 | 2.2 | 2.2 | 229 |
| **24176CAMK30E4** | 402 | — | 598 | 529 | 4 | 0.38 | 2.6 | 1.8 | 1.7 | 275 |
| **23276CAMKE4** | 408 | — | 652 | 578 | 5 | 0.35 | 2.9 | 1.9 | 1.9 | 372 |

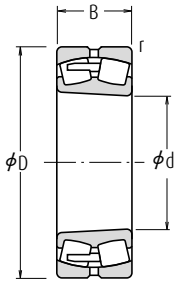
**Remarks**

1. The bearings denoted by an asterisk (*) are NSKHPS bearings and an oil groove and holes are standard for them.
2. When making a selection of the recommended fit (Tolerance of shaft) on Page A164, in case of NSKHPS bearings, the conditions are different.
   The segmentations are: Light Loads ($\leqq 0.05C_r$); Normal Loads (0.05 to $0.10C_r$); and Heavy Loads ($>0.10C_r$).
3. For the dimensions of adapters and withdrawal sleeves, refer to Pages **B382 and B388**.

## Bore Diameter 400 – 460 mm




Cylindrical Bore
CA



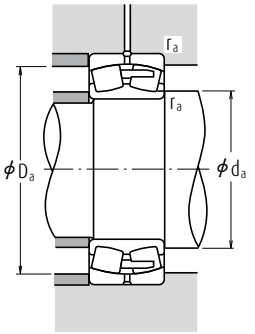

Tapered Bore
CA



Without an Oil Groove and Holes
CA

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Thermal Reference Speed | Speeds ($min^{-1}$) | | Bearing |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Limiting Speeds | | |
| d | D | B | r min. | $C_r$ | $C_{0r}$ | | Mechanical | Grease | Cylindrical Bore |
| **400** | 540 | 106 | 4 | 2 370 000 | 4 250 000 | 1 000 | 1 400 | 530 | **23980CAME4**[1] |
| | 600 | 148 | 5 | 3 700 000 | 5 900 000 | 800 | 1 300 | 480 | **23080CAME4**[1] |
| | 600 | 200 | 5 | 4 500 000 | 7 600 000 | 550 | 1 100 | 400 | **24080CAME4**[1] |
| | 650 | 200 | 6 | 4 150 000 | 7 900 000 | 500 | – | 380 | **23180CAME4** |
| | 650 | 250 | 6 | 4 950 000 | 10 100 000 | 320 | – | 380 | **24180CAME4** |
| | 720 | 256 | 6 | 5 800 000 | 10 400 000 | 380 | – | 340 | **23280CAME4** |
| **420** | 560 | 106 | 4 | 2 340 000 | 4 250 000 | 1 000 | 1 400 | 500 | **23984CAME4**[1] |
| | 620 | 150 | 5 | 2 910 000 | 5 850 000 | 670 | – | 450 | **23084CAME4** |
| | 620 | 200 | 5 | 3 750 000 | 8 100 000 | 480 | – | 380 | **24084CAME4** |
| | 700 | 224 | 6 | 5 000 000 | 9 400 000 | 480 | – | 340 | **23184CAME4** |
| | 700 | 280 | 6 | 6 000 000 | 12 000 000 | 280 | – | 340 | **24184CAME4** |
| | 760 | 272 | 7.5 | 6 450 000 | 11 700 000 | 360 | – | 320 | **23284CAME4** |
| **440** | 600 | 118 | 4 | 2 190 000 | 4 800 000 | 630 | – | 450 | **23988CAME4** |
| | 650 | 157 | 6 | 3 150 000 | 6 350 000 | 630 | – | 430 | **23088CAME4** |
| | 650 | 212 | 6 | 4 150 000 | 9 100 000 | 450 | – | 360 | **24088CAME4** |
| | 720 | 226 | 6 | 5 300 000 | 10 300 000 | 430 | – | 320 | **23188CAME4** |
| | 720 | 280 | 6 | 6 000 000 | 12 100 000 | 280 | – | 320 | **24188CAME4** |
| | 790 | 280 | 7.5 | 6 900 000 | 12 800 000 | 340 | – | 300 | **23288CAME4** |
| **460** | 620 | 118 | 4 | 2 220 000 | 4 950 000 | 600 | – | 430 | **23992CAME4** |
| | 680 | 163 | 6 | 3 450 000 | 7 100 000 | 600 | – | 400 | **23092CAME4** |
| | 680 | 218 | 6 | 4 500 000 | 9 950 000 | 430 | – | 340 | **24092CAME4** |
| | 760 | 240 | 7.5 | 5 700 000 | 10 900 000 | 430 | – | 300 | **23192CAME4** |
| | 760 | 300 | 7.5 | 6 300 000 | 12 400 000 | 280 | – | 300 | **24192CAME4** |
| | 830 | 296 | 7.5 | 7 350 000 | 13 700 000 | 320 | – | 280 | **23292CAME4** |

**Note** (1) The suffix K or K30 represents bearings with tapered bores (taper 1 : 12 or 1 : 30).




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | $Y_3$ | 0.67 | $Y_2$ |

## Static Equivalent Load

$P_0=F_r+Y_0F_a$

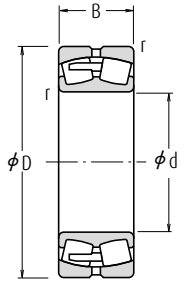
The values of e, $Y_2$ , $Y_3$ and $Y_0$ are given in the table below.

| Numbers | Abutment and Fillet Dimensions (mm) | | | | | Constant | Axial Load Factors | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $d_a$ | | $D_a$ | | $r_a$ | | | | | |
| Tapered Bore (1) | min. | max. | max. | min. | max. | e | $Y_2$ | $Y_3$ | $Y_0$ | approx. |
| **23980CAMKE4*** | 418 | — | 522 | 501 | 3 | 0.18 | 5.7 | 3.9 | 3.8 | 69.1 |
| **23080CAMKE4*** | 422 | — | 578 | 540 | 4 | 0.23 | 4.4 | 3.0 | 2.9 | 146 |
| **24080CAMK30E4*** | 422 | — | 578 | 527 | 4 | 0.31 | 3.3 | 2.2 | 2.2 | 193 |
| **23180CAMKE4** | 428 | — | 622 | 569 | 5 | 0.29 | 3.4 | 2.3 | 2.3 | 257 |
| **24180CAMK30E4** | 428 | — | 622 | 551 | 5 | 0.37 | 2.7 | 1.8 | 1.8 | 316 |
| **23280CAMKE4** | 428 | — | 692 | 610 | 5 | 0.36 | 2.8 | 1.9 | 1.9 | 449 |
| **23984CAMKE4*** | 438 | — | 542 | 521 | 3 | 0.17 | 6.0 | 4.0 | 3.9 | 71.6 |
| **23084CAMKE4** | 442 | — | 598 | 562 | 4 | 0.23 | 4.3 | 2.9 | 2.8 | 151 |
| **24084CAMK30E4** | 442 | — | 598 | 549 | 4 | 0.31 | 3.2 | 2.2 | 2.1 | 199 |
| **23184CAMKE4** | 448 | — | 672 | 607 | 5 | 0.31 | 3.3 | 2.2 | 2.2 | 341 |
| **24184CAMK30E4** | 448 | — | 672 | 598 | 5 | 0.38 | 2.6 | 1.8 | 1.7 | 421 |
| **23284CAMKE4** | 456 | — | 724 | 644 | 6 | 0.35 | 2.9 | 1.9 | 1.9 | 534 |
| **23988CAMKE4** | 458 | — | 582 | 555 | 3 | 0.18 | 5.7 | 3.9 | 3.8 | 96.3 |
| **23088CAMKE4** | 468 | — | 622 | 587 | 5 | 0.23 | 4.3 | 2.9 | 2.8 | 173 |
| **24088CAMK30E4** | 468 | — | 622 | 576 | 5 | 0.31 | 3.2 | 2.1 | 2.1 | 237 |
| **23188CAMKE4** | 468 | — | 692 | 627 | 5 | 0.3 | 3.3 | 2.2 | 2.2 | 360 |
| **24188CAMK30E4** | 468 | — | 692 | 617 | 5 | 0.37 | 2.7 | 1.8 | 1.8 | 433 |
| **23288CAMKE4** | 476 | — | 754 | 669 | 6 | 0.35 | 2.9 | 1.9 | 1.9 | 594 |
| **23992CAMKE4** | 478 | — | 602 | 575 | 3 | 0.17 | 5.9 | 4.0 | 3.9 | 100 |
| **23092CAMKE4** | 488 | — | 652 | 615 | 5 | 0.22 | 4.6 | 3.1 | 3.0 | 201 |
| **24092CAMK30E4** | 488 | — | 652 | 604 | 5 | 0.29 | 3.4 | 2.3 | 2.3 | 266 |
| **23192CAMKE4** | 496 | — | 724 | 661 | 6 | 0.31 | 3.3 | 2.2 | 2.2 | 423 |
| **24192CAMK30E4** | 496 | — | 724 | 646 | 6 | 0.39 | 2.6 | 1.7 | 1.7 | 512 |
| **23292CAMKE4** | 496 | — | 794 | 702 | 6 | 0.37 | 2.8 | 1.9 | 1.8 | 691 |

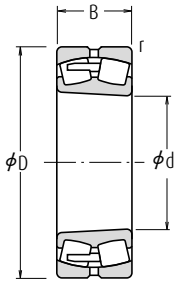
**Remarks**

1. The bearings denoted by an asterisk (*) are NSKHPS bearings and an oil groove and holes are standard for them.
2. When making a selection of the recommended fit (Tolerance of shaft) on Page A164, in case of NSKHPS bearings, the conditions are different.
   The segmentations are: Light Loads ($\leqq 0.05C_r$); Normal Loads (0.05 to $0.10C_r$); and Heavy Loads ($>0.10C_r$).
3. For the dimensions of adapters and withdrawal sleeves, refer to Pages **B382 – B383 and B389**.

## Bore Diameter 480 – 560 mm




Cylindrical Bore
CA



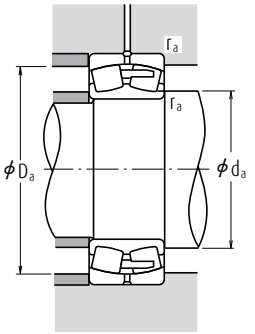

Tapered Bore
CA



Without an Oil Groove and Holes
CA

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Thermal Reference Speed | Speeds ($min^{-1}$) | | Bearing |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Limiting Speeds | | |
| d | D | B | r min. | $C_r$ | $C_{0r}$ | | Mechanical | Grease | Cylindrical Bore |
| **480** | 650 | 128 | 5 | 2 580 000 | 5 850 000 | 560 | – | 400 | **23996CAME4** |
| | 700 | 165 | 6 | 3 800 000 | 7 950 000 | 560 | – | 400 | **23096CAME4** |
| | 700 | 218 | 6 | 4 600 000 | 10 200 000 | 400 | – | 320 | **24096CAME4** |
| | 790 | 248 | 7.5 | 6 050 000 | 11 700 000 | 400 | – | 300 | **23196CAME4** |
| | 790 | 308 | 7.5 | 7 150 000 | 14 600 000 | 240 | – | 300 | **24196CAME4** |
| | 870 | 310 | 7.5 | 7 850 000 | 14 400 000 | 300 | – | 260 | **23296CAME4** |
| **500** | 670 | 128 | 5 | 2 460 000 | 5 550 000 | 560 | – | 400 | **239/500CAME4** |
| | 720 | 167 | 6 | 3 750 000 | 8 100 000 | 530 | – | 380 | **230/500CAME4** |
| | 720 | 218 | 6 | 4 450 000 | 9 900 000 | 400 | – | 300 | **240/500CAME4** |
| | 830 | 264 | 7.5 | 6 850 000 | 13 400 000 | 360 | – | 280 | **231/500CAME4** |
| | 830 | 325 | 7.5 | 8 000 000 | 16 000 000 | 220 | – | 280 | **241/500CAME4** |
| | 920 | 336 | 7.5 | 9 000 000 | 16 600 000 | 280 | – | 260 | **232/500CAME4** |
| **530** | 710 | 136 | 5 | 2 930 000 | 6 800 000 | 500 | – | 360 | **239/530CAME4** |
| | 780 | 185 | 6 | 4 440 000 | 9 200 000 | 500 | – | 340 | **230/530CAME4** |
| | 780 | 250 | 6 | 5 400 000 | 11 800 000 | 360 | – | 280 | **240/530CAME4** |
| | 870 | 272 | 7.5 | 7 150 000 | 14 100 000 | 340 | – | 260 | **231/530CAME4** |
| | 870 | 335 | 7.5 | 8 500 000 | 17 500 000 | 200 | – | 260 | **241/530CAME4** |
| | 980 | 355 | 9.5 | 10 100 000 | 18 800 000 | 260 | – | 240 | **232/530CAME4** |
| **560** | 750 | 140 | 5 | 3 100 000 | 7 250 000 | 480 | – | 340 | **239/560CAME4** |
| | 820 | 195 | 6 | 5 000 000 | 10 700 000 | 450 | – | 320 | **230/560CAME4** |
| | 820 | 258 | 6 | 5 950 000 | 13 300 000 | 340 | – | 260 | **240/560CAME4** |
| | 920 | 280 | 7.5 | 7 850 000 | 15 500 000 | 320 | – | 240 | **231/560CAME4** |
| | 920 | 355 | 7.5 | 9 400 000 | 19 600 000 | 190 | – | 240 | **241/560CAME4** |
| | 1 030 | 365 | 9.5 | 10 900 000 | 20 500 000 | 240 | – | 220 | **232/560CAME4** |

**Note** (1) The suffix K or K30 represents bearings with tapered bores (taper 1 : 12 or 1 : 30).




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | $Y_3$ | 0.67 | $Y_2$ |

## Static Equivalent Load

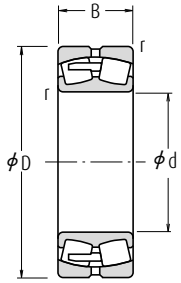
$P_0=F_r+Y_0F_a$

The values of e, $Y_2$ , $Y_3$ and $Y_0$ are given in the table below.

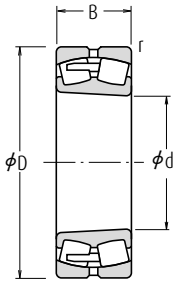
| Numbers | Abutment and Fillet Dimensions (mm) | | | | | Constant | Axial Load Factors | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $d_a$ | | $D_a$ | | $r_a$ | | | | | |
| Tapered Bore (1) | min. | max. | max. | min. | max. | e | $Y_2$ | $Y_3$ | $Y_0$ | approx. |
| **23996CAMKE4** | 502 | – | 628 | 602 | 4 | 0.18 | 5.7 | 3.8 | 3.7 | 121 |
| **23096CAMKE4** | 508 | – | 672 | 633 | 5 | 0.22 | 4.6 | 3.1 | 3.0 | 211 |
| **24096CAMK30E4** | 508 | – | 672 | 625 | 5 | 0.30 | 3.4 | 2.3 | 2.2 | 270 |
| **23196CAMKE4** | 516 | – | 754 | 688 | 6 | 0.31 | 3.3 | 2.2 | 2.2 | 475 |
| **24196CAMK30E4** | 516 | – | 754 | 670 | 6 | 0.37 | 2.6 | 1.7 | 1.7 | 567 |
| **23296CAMKE4** | 516 | – | 834 | 733 | 6 | 0.36 | 2.8 | 1.9 | 1.8 | 795 |
| **239/500CAMKE4** | 522 | – | 648 | 622 | 4 | 0.17 | 6.0 | 4.0 | 3.9 | 124 |
| **230/500CAMKE4** | 528 | – | 692 | 655 | 5 | 0.21 | 4.8 | 3.2 | 3.1 | 220 |
| **240/500CAMK30E4** | 528 | – | 692 | 643 | 5 | 0.30 | 3.4 | 2.3 | 2.2 | 276 |
| **231/500CAMKE4** | 536 | – | 794 | 720 | 6 | 0.31 | 3.2 | 2.2 | 2.1 | 567 |
| **241/500CAMK30E4** | 536 | – | 794 | 703 | 6 | 0.39 | 2.6 | 1.7 | 1.7 | 666 |
| **232/500CAMKE4** | 536 | – | 884 | 773 | 6 | 0.38 | 2.7 | 1.8 | 1.8 | 969 |
| **239/530CAMKE4** | 552 | – | 688 | 659 | 4 | 0.17 | 6.0 | 4.0 | 3.9 | 149 |
| **230/530CAMKE4** | 558 | – | 752 | 706 | 5 | 0.22 | 4.6 | 3.1 | 3.0 | 298 |
| **240/530CAMK30E4** | 558 | – | 752 | 690 | 5 | 0.31 | 3.3 | 2.2 | 2.2 | 390 |
| **231/530CAMKE4** | 566 | – | 834 | 758 | 6 | 0.30 | 3.3 | 2.2 | 2.2 | 628 |
| **241/530CAMK30E4** | 566 | – | 834 | 740 | 6 | 0.38 | 2.6 | 1.8 | 1.7 | 773 |
| **232/530CAMKE4** | 574 | – | 936 | 824 | 8 | 0.38 | 2.7 | 1.8 | 1.7 | 1 170 |
| **239/560CAMKE4** | 582 | – | 728 | 697 | 4 | 0.16 | 6.1 | 4.1 | 4.0 | 172 |
| **230/560CAMKE4** | 588 | – | 792 | 742 | 5 | 0.22 | 4.5 | 3.0 | 2.9 | 344 |
| **240/560CAMK30E4** | 588 | – | 792 | 729 | 5 | 0.30 | 3.3 | 2.2 | 2.2 | 440 |
| **231/560CAMKE4** | 596 | – | 884 | 804 | 6 | 0.30 | 3.4 | 2.3 | 2.2 | 727 |
| **241/560CAMK30E4** | 596 | – | 884 | 782 | 6 | 0.39 | 2.6 | 1.8 | 1.7 | 886 |
| **232/560CAMKE4** | 604 | – | 986 | 870 | 8 | 0.36 | 2.8 | 1.9 | 1.8 | 1 320 |

**Remark** For the dimensions of adapters (d=470 mm) and withdrawal sleeves, refer to Pages **B383 and B389**.

## Bore Diameter 600 – 750 mm



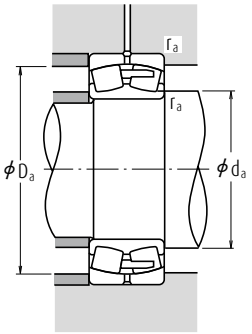

Cylindrical Bore
CA




Tapered Bore
CA

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Thermal Reference Speed | Speeds ($min^{-1}$) | | Bearing |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Limiting Speeds | | |
| d | D | B | r min. | $C_r$ | $C_{0r}$ | | Mechanical | Grease | Cylindrical Bore |
| **600** | 800 | 150 | 5 | 3 450 000 | 8 100 000 | 450 | – | 320 | **239/600CAME4** |
| | 870 | 200 | 6 | 5 450 000 | 12 200 000 | 400 | – | 300 | **230/600CAME4** |
| | 870 | 272 | 6 | 6 600 000 | 15 100 000 | 300 | – | 240 | **240/600CAME4** |
| | 980 | 300 | 7.5 | 8 750 000 | 17 500 000 | 280 | – | 220 | **231/600CAME4** |
| | 980 | 375 | 7.5 | 10 400 000 | 21 900 000 | 170 | – | 220 | **241/600CAME4** |
| | 1 090 | 388 | 9.5 | 12 700 000 | 24 900 000 | 200 | – | 200 | **232/600CAME4** |
| **630** | 850 | 165 | 6 | 4 000 000 | 9 350 000 | 400 | – | 300 | **239/630CAME4** |
| | 920 | 212 | 7.5 | 5 900 000 | 12 700 000 | 400 | – | 280 | **230/630CAME4** |
| | 920 | 290 | 7.5 | 7 550 000 | 17 700 000 | 280 | – | 220 | **240/630CAME4** |
| | 1 030 | 315 | 7.5 | 9 600 000 | 19 400 000 | 260 | – | 200 | **231/630CAME4** |
| | 1 030 | 400 | 7.5 | 11 300 000 | 23 900 000 | 160 | – | 200 | **241/630CAME4** |
| | 1 150 | 412 | 12 | 13 400 000 | 25 600 000 | 200 | – | 180 | **232/630CAME4** |
| **670** | 900 | 170 | 6 | 4 350 000 | 10 300 000 | 380 | – | 260 | **239/670CAME4** |
| | 980 | 230 | 7.5 | 6 850 000 | 15 000 000 | 360 | – | 240 | **230/670CAME4** |
| | 980 | 308 | 7.5 | 8 450 000 | 19 500 000 | 260 | – | 200 | **240/670CAME4** |
| | 1 090 | 336 | 7.5 | 10 600 000 | 21 600 000 | 240 | – | 190 | **231/670CAME4** |
| | 1 090 | 412 | 7.5 | 12 400 000 | 26 500 000 | 150 | – | 190 | **241/670CAME4** |
| | 1 220 | 438 | 12 | 14 900 000 | 28 700 000 | 180 | – | 170 | **232/670CAME4** |
| **710** | 950 | 180 | 6 | 4 800 000 | 11 700 000 | 360 | – | 240 | **239/710CAME4** |
| | 1 030 | 236 | 7.5 | 7 100 000 | 15 800 000 | 340 | – | 240 | **230/710CAME4** |
| | 1 030 | 315 | 7.5 | 8 850 000 | 20 700 000 | 240 | – | 190 | **240/710CAME4** |
| | 1 150 | 438 | 9.5 | 13 900 000 | 30 500 000 | 130 | – | 170 | **241/710CAME4** |
| | 1 280 | 450 | 12 | 15 700 000 | 30 500 000 | 170 | – | 160 | **232/710CAME4** |
| **750** | 1 000 | 185 | 6 | 5 250 000 | 12 800 000 | 320 | – | 220 | **239/750CAME4** |
| | 1 090 | 250 | 7.5 | 7 750 000 | 17 200 000 | 320 | – | 220 | **230/750CAME4** |
| | 1 090 | 335 | 7.5 | 10 100 000 | 24 000 000 | 220 | – | 180 | **240/750CAME4** |
| | 1 360 | 475 | 15 | 17 700 000 | 35 500 000 | 150 | – | 140 | **232/750CAME4** |

**Note** (1) The suffix K or K30 represents bearings with tapered bores (taper 1 : 12 or 1 : 30).




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | $Y_3$ | 0.67 | $Y_2$ |

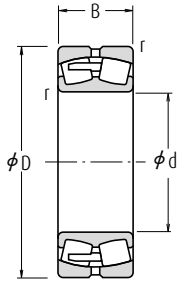
## Static Equivalent Load

$P_0=F_r+Y_0F_a$

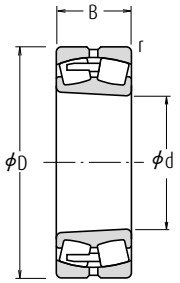
The values of e, $Y_2$ , $Y_3$ and $Y_0$ are given in the table below.

| Numbers | Abutment and Fillet Dimensions (mm) | | | | | Constant | Axial Load Factors | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $d_a$ | | $D_a$ | | $r_a$ | | | | | |
| Tapered Bore (1) | min. | max. | max. | min. | max. | e | $Y_2$ | $Y_3$ | $Y_0$ | approx. |
| **239/600CAMKE4** | 622 | – | 778 | 745 | 4 | 0.17 | 5.9 | 3.9 | 3.9 | 205 |
| **230/600CAMKE4** | 628 | – | 842 | 794 | 5 | 0.21 | 4.8 | 3.3 | 3.2 | 389 |
| **240/600CAMK30E4** | 628 | – | 842 | 772 | 5 | 0.30 | 3.3 | 2.2 | 2.2 | 529 |
| **231/600CAMKE4** | 636 | – | 944 | 856 | 6 | 0.30 | 3.4 | 2.3 | 2.2 | 898 |
| **241/600CAMK30E4** | 636 | – | 944 | 836 | 6 | 0.39 | 2.6 | 1.8 | 1.7 | 1 050 |
| **232/600CAMKE4** | 644 | – | 1 046 | 923 | 8 | 0.36 | 2.8 | 1.9 | 1.8 | 1 590 |
| **239/630CAMKE4** | 658 | – | 822 | 786 | 5 | 0.18 | 5.6 | 3.8 | 3.7 | 259 |
| **230/630CAMKE4** | 666 | – | 884 | 835 | 6 | 0.22 | 4.7 | 3.1 | 3.1 | 468 |
| **240/630CAMK30E4** | 666 | – | 884 | 815 | 6 | 0.30 | 3.3 | 2.2 | 2.2 | 637 |
| **231/630CAMKE4** | 666 | – | 994 | 900 | 6 | 0.30 | 3.4 | 2.3 | 2.2 | 1 040 |
| **241/630CAMK30E4** | 666 | – | 994 | 876 | 6 | 0.38 | 2.7 | 1.8 | 1.7 | 1 250 |
| **232/630CAMKE4** | 684 | – | 1 096 | 970 | 10 | 0.37 | 2.8 | 1.9 | 1.8 | 1 850 |
| **239/670CAMKE4** | 698 | – | 872 | 836 | 5 | 0.17 | 5.8 | 3.9 | 3.8 | 300 |
| **230/670CAMKE4** | 706 | – | 944 | 891 | 6 | 0.22 | 4.7 | 3.1 | 3.1 | 571 |
| **240/670CAMK30E4** | 706 | – | 944 | 868 | 6 | 0.30 | 3.3 | 2.2 | 2.2 | 773 |
| **231/670CAMKE4** | 706 | – | 1 054 | 952 | 6 | 0.30 | 3.3 | 2.2 | 2.2 | 1 230 |
| **241/670CAMK30E4** | 706 | – | 1 054 | 934 | 6 | 0.37 | 2.7 | 1.8 | 1.8 | 1 440 |
| **232/670CAMKE4** | 724 | – | 1 166 | 1 024 | 10 | 0.37 | 2.7 | 1.8 | 1.8 | 2 210 |
| **239/710CAMKE4** | 738 | – | 922 | 883 | 5 | 0.17 | 5.8 | 3.9 | 3.8 | 352 |
| **230/710CAMKE4** | 746 | – | 994 | 936 | 6 | 0.22 | 4.6 | 3.1 | 3.0 | 647 |
| **240/710CAMK30E4** | 746 | – | 994 | 916 | 6 | 0.29 | 3.4 | 2.3 | 2.2 | 861 |
| **241/710CAMK30E4** | 754 | – | 1 106 | 981 | 8 | 0.38 | 2.6 | 1.8 | 1.7 | 1 730 |
| **232/710CAMKE4** | 764 | – | 1 226 | 1 080 | 10 | 0.36 | 2.8 | 1.9 | 1.8 | 2 470 |
| **239/750CAMKE4** | 778 | – | 972 | 931 | 5 | 0.17 | 6.0 | 4.1 | 4.0 | 398 |
| **230/750CAMKE4** | 786 | – | 1 054 | 990 | 6 | 0.22 | 4.6 | 3.1 | 3.0 | 768 |
| **240/750CAMK30E4** | 786 | – | 1 054 | 969 | 6 | 0.29 | 3.4 | 2.3 | 2.2 | 1 030 |
| **232/750CAMKE4** | 814 | – | 1 296 | 1 148 | 12 | 0.36 | 2.8 | 1.9 | 1.8 | 2 980 |

## Bore Diameter 800 – 1400 mm



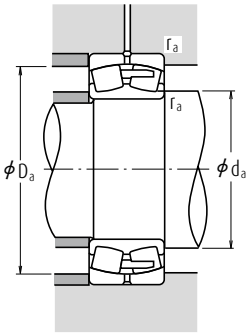

Cylindrical Bore
CA




Tapered Bore
CA

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Thermal Reference Speed | Speeds ($min^{-1}$) | | Bearing |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Limiting Speeds | | |
| d | D | B | r min. | $C_r$ | $C_{0r}$ | | Mechanical | Grease | Cylindrical Bore |
| **800** | 1 060 | 195 | 6 | 5 600 000 | 13 700 000 | 300 | – | 220 | **239/800CAME4** |
| | 1 150 | 258 | 7.5 | 8 350 000 | 19 100 000 | 300 | – | 200 | **230/800CAME4** |
| | 1 150 | 345 | 7.5 | 10 900 000 | 26 300 000 | 200 | – | 160 | **240/800CAME4** |
| | 1 280 | 375 | 9.5 | 13 800 000 | 29 200 000 | 190 | – | 150 | **231/800CAME4** |
| | 1 420 | 488 | 15 | 20 300 000 | 41 000 000 | 130 | – | 130 | **232/800CAME4** |
| **850** | 1 120 | 200 | 6 | 6 100 000 | 15 200 000 | 280 | – | 190 | **239/850CAME4** |
| | 1 220 | 272 | 7.5 | 9 300 000 | 21 400 000 | 280 | – | 180 | **230/850CAME4** |
| | 1 220 | 365 | 7.5 | 11 600 000 | 28 300 000 | 190 | – | 150 | **240/850CAME4** |
| | 1 500 | 515 | 15 | 22 300 000 | 45 500 000 | 120 | – | 120 | **232/850CAME4** |
| **900** | 1 180 | 206 | 6 | 6 660 000 | 16 700 000 | 260 | – | 180 | **239/900CAME4** |
| | 1 280 | 280 | 7.5 | 9 850 000 | 22 800 000 | 260 | – | 160 | **230/900CAME4** |
| | 1 280 | 375 | 7.5 | 12 800 000 | 31 500 000 | 170 | – | 140 | **240/900CAME4** |
| | 1 580 | 515 | 15 | 23 400 000 | 47 500 000 | 120 | – | 110 | **232/900CAME4** |
| **950** | 1 250 | 224 | 7.5 | 7 600 000 | 19 900 000 | 240 | – | 160 | **239/950CAME4** |
| | 1 360 | 300 | 7.5 | 11 300 000 | 26 500 000 | 240 | – | 150 | **230/950CAME4** |
| | 1 360 | 412 | 7.5 | 14 500 000 | 36 500 000 | 160 | – | 120 | **240/950CAME4** |
| | 1 660 | 530 | 15 | 24 700 000 | 50 500 000 | 110 | – | 100 | **232/950CAME4** |
| **1 000** | 1 320 | 236 | 7.5 | 8 200 000 | 21 700 000 | 220 | – | 150 | **239/1000CAME4** |
| | 1 420 | 308 | 7.5 | 11 900 000 | 28 100 000 | 220 | – | 140 | **230/1000CAME4** |
| | 1 420 | 412 | 7.5 | 15 300 000 | 38 500 000 | 150 | – | 110 | **240/1000CAME4** |
| **1 060** | 1 400 | 250 | 7.5 | 9 300 000 | 24 400 000 | 200 | – | 130 | **239/1060CAME4** |
| | 1 500 | 325 | 9.5 | 13 000 000 | 31 500 000 | 200 | – | 120 | **230/1060CAME4** |
| | 1 500 | 438 | 9.5 | 16 800 000 | 43 000 000 | 140 | – | 100 | **240/1060CAME4** |
| **1 120** | 1 580 | 345 | 9.5 | 15 400 000 | 38 000 000 | 180 | – | 110 | **230/1120CAME4** |
| | 1 580 | 462 | 9.5 | 18 700 000 | 49 500 000 | 120 | – | 95 | **240/1120CAME4** |
| **1 180** | 1 660 | 475 | 9.5 | 20 200 000 | 52 500 000 | 120 | – | 85 | **240/1180CAME4** |
| **1 250** | 1 750 | 500 | 9.5 | 21 000 000 | 59 500 000 | 110 | – | 75 | **240/1250CAME4** |
| **1 320** | 1 850 | 530 | 12 | 22 600 000 | 63 500 000 | 100 | – | 67 | **240/1320CAME4** |
| **1 400** | 1 950 | 545 | 12 | 24 500 000 | 65 000 000 | 95 | – | 60 | **240/1400CAME4** |

**Note** (1) The suffix K or K30 represents bearings with tapered bores (taper 1 : 12 or 1 : 30).




## Dynamic Equivalent Load $P=XF_r+YF_a$

| $F_a/F_r \leq e$ | | $F_a/F_r > e$ | |
|---|---|---|---|
| X | Y | X | Y |
| 1 | $Y_3$ | 0.67 | $Y_2$ |

## Static Equivalent Load

$P_0=F_r+Y_0F_a$

The values of e, $Y_2$ , $Y_3$ and $Y_0$ are given in the table below.

| Numbers | Abutment and Fillet Dimensions (mm) | | | | | Constant | Axial Load Factors | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $d_a$ | | $D_a$ | | $r_a$ | | | | | |
| Tapered Bore (1) | min. | max. | max. | min. | max. | e | $Y_2$ | $Y_3$ | $Y_0$ | approx. |
| **239/800CAMKE4** | 828 | – | 1 032 | 987 | 5 | 0.17 | 6.0 | 4.0 | 3.9 | 462 |
| **230/800CAMKE4** | 836 | – | 1 114 | 1 045 | 6 | 0.21 | 4.7 | 3.2 | 3.1 | 870 |
| **240/800CAMK30E4** | 836 | – | 1 114 | 1 029 | 6 | 0.27 | 3.7 | 2.5 | 2.5 | 1 130 |
| **231/800CAMKE4** | 844 | – | 1 236 | 1 127 | 8 | 0.28 | 3.6 | 2.4 | 2.3 | 1 870 |
| **232/800CAMKE4** | 864 | – | 1 356 | 1 208 | 12 | 0.35 | 2.8 | 1.9 | 1.9 | 3 250 |
| **239/850CAMKE4** | 878 | – | 1 092 | 1 046 | 5 | 0.16 | 6.2 | 4.2 | 4.1 | 523 |
| **230/850CAMKE4** | 886 | – | 1 184 | 1 109 | 6 | 0.21 | 4.8 | 3.2 | 3.1 | 1 020 |
| **240/850CAMK30E4** | 886 | – | 1 184 | 1 093 | 6 | 0.28 | 3.6 | 2.4 | 2.4 | 1 350 |
| **232/850CAMKE4** | 914 | – | 1 436 | 1 274 | 12 | 0.35 | 2.8 | 1.9 | 1.9 | 3 890 |
| **239/900CAMKE4** | 928 | – | 1 152 | 1 103 | 5 | 0.16 | 6.4 | 4.3 | 4.2 | 591 |
| **230/900CAMKE4** | 936 | – | 1 244 | 1 169 | 6 | 0.20 | 4.9 | 3.3 | 3.2 | 1 160 |
| **240/900CAMK30E4** | 936 | – | 1 244 | 1 147 | 6 | 0.28 | 3.6 | 2.4 | 2.4 | 1 520 |
| **232/900CAMKE4** | 964 | – | 1 516 | 1 354 | 12 | 0.33 | 3.0 | 2.0 | 2.0 | 4 300 |
| **239/950CAMKE4** | 986 | – | 1 214 | 1 169 | 6 | 0.16 | 6.3 | 4.2 | 4.1 | 732 |
| **230/950CAMKE4** | 986 | – | 1 324 | 1 241 | 6 | 0.21 | 4.8 | 3.2 | 3.2 | 1 400 |
| **240/950CAMK30E4** | 986 | – | 1 324 | 1 219 | 6 | 0.28 | 3.6 | 2.4 | 2.3 | 1 880 |
| **232/950CAMKE4** | 1 014 | – | 1 596 | 1 428 | 12 | 0.32 | 3.1 | 2.1 | 2.1 | 4 800 |
| **239/1000CAMKE4** | 1 036 | – | 1 284 | 1 229 | 6 | 0.16 | 6.4 | 4.3 | 4.2 | 881 |
| **230/1000CAMKE4** | 1 036 | – | 1 384 | 1 298 | 6 | 0.20 | 4.9 | 3.3 | 3.2 | 1 560 |
| **240/1000CAMK30E4** | 1 036 | – | 1 384 | 1 275 | 6 | 0.27 | 3.7 | 2.5 | 2.4 | 2 010 |
| **239/1060CAMKE4** | 1 096 | – | 1 384 | 1 302 | 6 | 0.16 | 6.1 | 4.1 | 4.0 | 1 030 |
| **230/1060CAMKE4** | 1 104 | – | 1 456 | 1 368 | 8 | 0.21 | 4.9 | 3.3 | 3.2 | 1 790 |
| **240/1060CAMK30E4** | 1 104 | – | 1 456 | 1 346 | 8 | 0.28 | 3.6 | 2.4 | 2.4 | 2 410 |
| **230/1120CAMKE4** | 1 164 | – | 1 536 | 1 444 | 8 | 0.20 | 5.0 | 3.4 | 3.3 | 2 120 |
| **240/1120CAMK30E4** | 1 164 | – | 1 536 | 1 421 | 8 | 0.27 | 3.7 | 2.5 | 2.5 | 2 790 |
| **240/1180CAMK30E4** | 1 224 | – | 1 616 | 1 494 | 8 | 0.27 | 3.7 | 2.5 | 2.4 | 3 180 |
| **240/1250CAMK30E4** | 1 294 | – | 1 706 | 1 579 | 8 | 0.25 | 4.0 | 2.7 | 2.6 | 3 700 |
| **240/1320CAMK30E4** | 1 374 | – | 1 796 | 1 656 | 10 | 0.26 | 3.9 | 2.6 | 2.6 | 4 400 |
| **240/1400CAMK30E4** | 1 454 | – | 1 896 | 1 767 | 10 | 0.25 | 4.0 | 2.7 | 2.6 | 4 900 |


NSK

## 8. THRUST BALL BEARINGS


Page

Introduction.....B 314


## BEARINGS TABLE

### SINGLE-DIRECTION THRUST BALL BEARINGS


Bore Dia. Page

With Flat Seat, Aligning Seat, or Aligning Seat Washer 10 – 360 mm.....B 316


### DOUBLE-DIRECTION THRUST BALL BEARINGS


Bore Dia. Page

With Flat Seat, Aligning Seat, or Aligning Seat Washer 10 – 190 mm.....B 324

## DESIGN, TYPES, AND FEATURES

THRUST BALL BEARINGS

Thrust ball bearings are classified into those with flat seats or aligning seats depending on the shape of the outer ring seat (housing washer). They can sustain axial loads but no radial loads.

The series of thrust ball bearings available are shown in Table 1.

For Single-Direction Thrust Ball Bearings, pressed steel cages and machined brass cages are usually used as shown in Table 2. The cages in Double-Direction Thrust Ball Bearings are the same as those in Single-Direction Thrust Ball Bearings of the same diameter series.

The basic load ratings listed in the bearing tables are based on the standard cage type shown in Table 2.
If the type of cage is different for bearings with the same number, the number of balls may vary, in such a case, the load rating will differ from the one listed in the bearing tables.

**Table 1 Series of Thrust Ball Bearings**

| | W/Flat Seat | W/Aligning Seat | W/Aligning Seat Washer |
|---|---|---|---|
| Single-Direction | 511 | — | — |
| | 512 | 532 | 532U |
| | 513 | 533 | 533U |
| | 514 | 534 | 534U |
| Double-Direction | 522 | 542 | 542U |
| | 523 | 543 | 543U |
| | 524 | 544 | 544U |

**Table 2 Standard Cages for Thrust Ball Bearings**

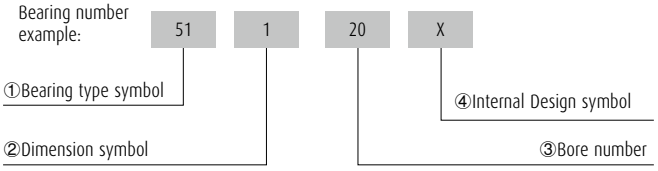
| Pressed Steel | Machined Brass |
|---|---|
| 51100 – 51152X | 51156X – 51172X |
| 51200 – 51236X | 51238X – 51272X |
| 51305 – 51336X | 51338X – 51340X |
| 51405 – 51418X | 51420X – 51436X |
| 53200 – 53236X | 53238X – 53272X |
| 53305 – 53336X | 53338X – 53340X |
| 53405 – 53418X | 53420X – 53436X |

## TOLERANCES AND RUNNING ACCURACY


| | Table | Pages |
|---|---|---|
| Thrust Ball Bearings | 7.6 | A140 to A142 |


## RECOMMENDED FITS


| | Table | Page |
|---|---|---|
| Thrust Ball Bearings | 8.4 | A164 |
| | 8.6 | A165 |


①Bearing type symbol: 51: single direction
52: double direction

②Dimension symbol: 1: 1 series
2: 2 series
3: 3 series
4: 4 series

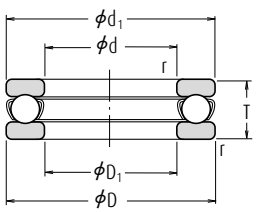
③Bore number:Less than 03, Bearing bore 00 : 10 mm, 01 : 12 mm,
02 : 15 mm, 03 : 17 mm
Over 04, Bearing bore Bore number ×5 (mm)

④Internal Design symbol: see note (1) in bearing tables

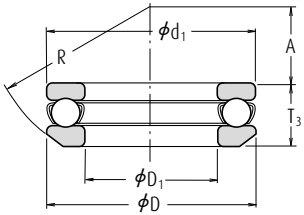
## MINIMUM AXIAL LOAD

It is necessary to apply some axial load to thrust bearings to prevent slippage between the rolling elements and raceways.
For more details, please refer to Page A198

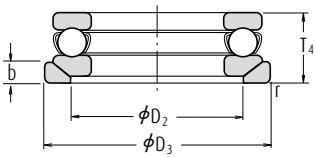
## Bore Diameter 10 – 50 mm




With Flat Seat

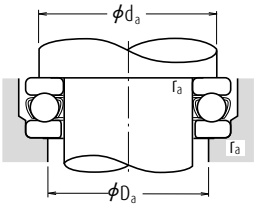


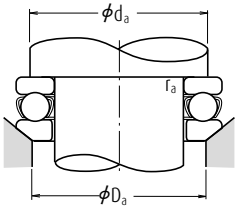

With Aligning Seat

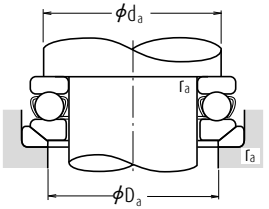



With Aligning Seat Washer

| Boundary Dimensions (mm) | | | | | | Basic Load Ratings (N) | | Limiting Speeds ($min^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| d | D | T | $T_3$ | $T_4$ | r min. | $C_a$ | $C_{0a}$ | Grease | Oil | With Flat Seat |
| **10** | 24 | 9 | – | – | 0.3 | 10 100 | 14 000 | 6 700 | 10 000 | **51100** |
| | 26 | 11 | 11.6 | 13 | 0.6 | 12 800 | 17 100 | 6 000 | 9 000 | **51200** |
| **12** | 26 | 9 | – | – | 0.3 | 10 400 | 15 400 | 6 700 | 10 000 | **51101** |
| | 28 | 11 | 11.4 | 13 | 0.6 | 13 300 | 19 000 | 5 600 | 8 500 | **51201** |
| **15** | 28 | 9 | – | – | 0.3 | 10 600 | 16 800 | 6 300 | 9 500 | **51102** |
| | 32 | 12 | 13.3 | 15 | 0.6 | 16 700 | 24 800 | 5 000 | 7 500 | **51202** |
| **17** | 30 | 9 | – | – | 0.3 | 11 400 | 19 500 | 6 000 | 9 000 | **51103** |
| | 35 | 12 | 13.2 | 15 | 0.6 | 17 300 | 27 300 | 4 800 | 7 500 | **51203** |
| **20** | 35 | 10 | – | – | 0.3 | 15 100 | 26 600 | 5 300 | 8 000 | **51104** |
| | 40 | 14 | 14.7 | 17 | 0.6 | 22 500 | 37 500 | 4 300 | 6 300 | **51204** |
| **25** | 42 | 11 | – | – | 0.6 | 19 700 | 37 000 | 4 800 | 7 100 | **51105** |
| | 47 | 15 | 16.7 | 19 | 0.6 | 28 000 | 50 500 | 3 800 | 5 600 | **51205** |
| | 52 | 18 | 19.8 | 22 | 1 | 36 000 | 61 500 | 3 200 | 5 000 | **51305** |
| | 60 | 24 | 26.4 | 29 | 1 | 56 000 | 89 500 | 2 600 | 4 000 | **51405** |
| **30** | 47 | 11 | – | – | 0.6 | 20 600 | 42 000 | 4 300 | 6 700 | **51106** |
| | 52 | 16 | 17.8 | 20 | 0.6 | 29 500 | 58 000 | 3 400 | 5 300 | **51206** |
| | 60 | 21 | 22.6 | 25 | 1 | 43 000 | 78 500 | 2 800 | 4 300 | **51306** |
| | 70 | 28 | 30.1 | 33 | 1 | 73 000 | 126 000 | 2 200 | 3 400 | **51406** |
| **35** | 52 | 12 | – | – | 0.6 | 22 100 | 49 500 | 4 000 | 6 000 | **51107** |
| | 62 | 18 | 19.9 | 22 | 1 | 39 500 | 78 000 | 3 000 | 4 500 | **51207** |
| | 68 | 24 | 25.6 | 28 | 1 | 56 000 | 105 000 | 2 400 | 3 800 | **51307** |
| | 80 | 32 | 34 | 37 | 1.1 | 87 500 | 155 000 | 2 000 | 3 000 | **51407** |
| **40** | 60 | 13 | – | – | 0.6 | 27 100 | 63 000 | 3 600 | 5 300 | **51108** |
| | 68 | 19 | 20.3 | 23 | 1 | 47 500 | 98 500 | 2 800 | 4 300 | **51208** |
| | 78 | 26 | 28.5 | 31 | 1 | 70 000 | 135 000 | 2 200 | 3 400 | **51308** |
| | 90 | 36 | 38.2 | 42 | 1.1 | 103 000 | 188 000 | 1 700 | 2 600 | **51408** |
| **45** | 65 | 14 | – | – | 0.6 | 28 100 | 69 000 | 3 400 | 5 000 | **51109** |
| | 73 | 20 | 21.3 | 24 | 1 | 48 000 | 105 000 | 2 600 | 4 000 | **51209** |
| | 85 | 28 | 30.1 | 33 | 1 | 80 500 | 163 000 | 2 000 | 3 000 | **51309** |
| | 100 | 39 | 42.4 | 46 | 1.1 | 128 000 | 246 000 | 1 600 | 2 400 | **51409** |
| **50** | 70 | 14 | – | – | 0.6 | 29 000 | 75 500 | 3 200 | 4 800 | **51110** |
| | 78 | 22 | 23.5 | 26 | 1 | 49 000 | 111 000 | 2 400 | 3 600 | **51210** |
| | 95 | 31 | 34.3 | 37 | 1.1 | 97 500 | 202 000 | 1 800 | 2 800 | **51310** |
| | 110 | 43 | 45.6 | 50 | 1.5 | 147 000 | 288 000 | 1 400 | 2 200 | **51410** |

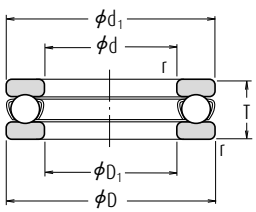


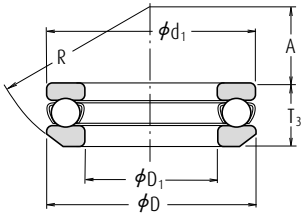




| Bearing Numbers | | Dimensions (mm) | | | | | | | Abutment and Fillet Dimensions (mm) | | | Mass (kg) approx. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| With Aligning Seat | With Aligning Seat Washer | $d_1$ | $D_1$ | $D_2$ | $D_3$ | b | A | R | $d_a$ min. | $D_a$ max. | $r_a$ max. | With Flat Seat | With Aligning Seat | With Aligning Seat Washer |
| — | — | 24 | 11 | — | — | — | — | — | 18 | 16 | 0.3 | 0.019 | — | — |
| **53200** | **53200 U** | 26 | 12 | 18 | 28 | 3.5 | 8.5 | 22 | 20 | 16 | 0.6 | 0.028 | 0.029 | 0.036 |
| — | — | 26 | 13 | — | — | — | — | — | 20 | 18 | 0.3 | 0.021 | — | — |
| **53201** | **53201 U** | 28 | 14 | 20 | 30 | 3.5 | 11.5 | 25 | 22 | 18 | 0.6 | 0.031 | 0.031 | 0.039 |
| — | — | 28 | 16 | — | — | — | — | — | 23 | 20 | 0.3 | 0.023 | — | — |
| **53202** | **53202 U** | 32 | 17 | 24 | 35 | 4 | 12 | 28 | 25 | 22 | 0.6 | 0.043 | 0.048 | 0.059 |
| — | — | 30 | 18 | — | — | — | — | — | 25 | 22 | 0.3 | 0.025 | — | — |
| **53203** | **53203 U** | 35 | 19 | 26 | 38 | 4 | 16 | 32 | 28 | 24 | 0.6 | 0.050 | 0.055 | 0.069 |
| — | — | 35 | 21 | — | — | — | — | — | 29 | 26 | 0.3 | 0.037 | — | — |
| **53204** | **53204 U** | 40 | 22 | 30 | 42 | 5 | 18 | 36 | 32 | 28 | 0.6 | 0.077 | 0.080 | 0.096 |
| — | — | 42 | 26 | — | — | — | — | — | 35 | 32 | 0.6 | 0.056 | — | — |
| **53205** | **53205 U** | 47 | 27 | 36 | 50 | 5.5 | 19 | 40 | 38 | 34 | 0.6 | 0.111 | 0.123 | 0.151 |
| **53305** | **53305 U** | 52 | 27 | 38 | 55 | 6 | 21 | 45 | 41 | 36 | 1 | 0.169 | 0.182 | 0.224 |
| **53405** | **53405 U** | 60 | 27 | 42 | 62 | 8 | 19 | 50 | 46 | 39 | 1 | 0.334 | 0.353 | 0.426 |
| — | — | 47 | 32 | — | — | — | — | — | 40 | 37 | 0.6 | 0.064 | — | — |
| **53206** | **53206 U** | 52 | 32 | 42 | 55 | 5.5 | 22 | 45 | 43 | 39 | 0.6 | 0.137 | 0.154 | 0.183 |
| **53306** | **53306 U** | 60 | 32 | 45 | 62 | 7 | 22 | 50 | 48 | 42 | 1 | 0.267 | 0.28 | 0.336 |
| **53406** | **53406 U** | 70 | 32 | 50 | 75 | 9 | 20 | 56 | 54 | 46 | 1 | 0.519 | 0.535 | 0.666 |
| — | — | 52 | 37 | — | — | — | — | — | 45 | 42 | 0.6 | 0.081 | — | — |
| **53207** | **53207 U** | 62 | 37 | 48 | 65 | 7 | 24 | 50 | 51 | 46 | 1 | 0.21 | 0.231 | 0.292 |
| **53307** | **53307 U** | 68 | 37 | 52 | 72 | 7.5 | 24 | 56 | 55 | 48 | 1 | 0.386 | 0.403 | 0.488 |
| **53407** | **53407 U** | 80 | 37 | 58 | 85 | 10 | 23 | 64 | 62 | 53 | 1 | 0.769 | 0.785 | 0.967 |
| — | — | 60 | 42 | — | — | — | — | — | 52 | 48 | 0.6 | 0.12 | — | — |
| **53208** | **53208 U** | 68 | 42 | 55 | 72 | 7 | 28.5 | 56 | 57 | 51 | 1 | 0.27 | 0.289 | 0.355 |
| **53308** | **53308 U** | 78 | 42 | 60 | 82 | 8.5 | 28 | 64 | 63 | 55 | 1 | 0.536 | 0.581 | 0.704 |
| **53408** | **53408 U** | 90 | 42 | 65 | 95 | 12 | 26 | 72 | 70 | 60 | 1 | 1.1 | 1.12 | 1.38 |
| — | — | 65 | 47 | — | — | — | — | — | 57 | 53 | 0.6 | 0.143 | — | — |
| **53209** | **53209 U** | 73 | 47 | 60 | 78 | 7.5 | 26 | 56 | 62 | 56 | 1 | 0.31 | 0.333 | 0.419 |
| **53309** | **53309 U** | 85 | 47 | 65 | 90 | 10 | 25 | 64 | 69 | 61 | 1 | 0.672 | 0.702 | 0.888 |
| **53409** | **53409 U** | 100 | 47 | 72 | 105 | 12.5 | 29 | 80 | 78 | 67 | 1 | 1.46 | 1.53 | 1.87 |
| — | — | 70 | 52 | — | — | — | — | — | 62 | 58 | 0.6 | 0.153 | — | — |
| **53210** | **53210 U** | 78 | 52 | 62 | 82 | 7.5 | 32.5 | 64 | 67 | 61 | 1 | 0.378 | 0.404 | 0.504 |
| **53310** | **53310 U** | 95 | 52 | 72 | 100 | 11 | 28 | 72 | 77 | 68 | 1 | 0.931 | 1.01 | 1.27 |
| **53410** | **53410 U** | 110 | 52 | 80 | 115 | 14 | 35 | 90 | 86 | 74 | 1.5 | 1.94 | 1.98 | 2.41 |

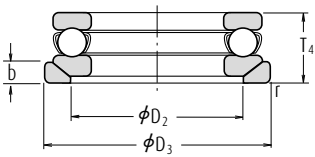
## Bore Diameter 55 – 100 mm




With Flat Seat



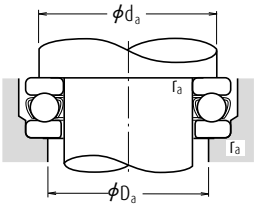

With Aligning Seat

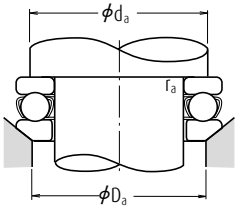


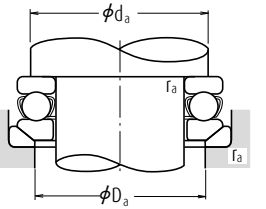

With Aligning Seat Washer

| Boundary Dimensions (mm) | | | | | | Basic Load Ratings (N) | | Limiting Speeds ($min^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| d | D | T | $T_3$ | $T_4$ | r min. | $C_a$ | $C_{0a}$ | Grease | Oil | With Flat Seat |
| **55** | 78 | 16 | – | – | 0.6 | 35 000 | 93 000 | 2 800 | 4 300 | **51111** |
| | 90 | 25 | 27.3 | 30 | 1 | 70 000 | 159 000 | 2 200 | 3 200 | **51211** |
| | 105 | 35 | 39.3 | 42 | 1.1 | 115 000 | 244 000 | 1 600 | 2 400 | **51311** |
| | 120 | 48 | 50.5 | 55 | 1.5 | 181 000 | 350 000 | 1 300 | 1 900 | **51411** |
| **60** | 85 | 17 | – | – | 1 | 41 500 | 113 000 | 2 600 | 4 000 | **51112** |
| | 95 | 26 | 28 | 31 | 1 | 71 500 | 169 000 | 2 000 | 3 000 | **51212** |
| | 110 | 35 | 38.3 | 42 | 1.1 | 119 000 | 263 000 | 1 600 | 2 400 | **51312** |
| | 130 | 51 | 54 | 58 | 1.5 | 202 000 | 395 000 | 1 200 | 1 800 | **51412** |
| **65** | 90 | 18 | – | – | 1 | 42 000 | 117 000 | 2 400 | 3 800 | **51113** |
| | 100 | 27 | 28.7 | 32 | 1 | 75 500 | 189 000 | 1 900 | 2 800 | **51213** |
| | 115 | 36 | 39.4 | 43 | 1.1 | 123 000 | 282 000 | 1 500 | 2 400 | **51313** |
| | 140 | 56 | 60.2 | 65 | 2 | 234 000 | 495 000 | 1 100 | 1 700 | **51413** |
| **70** | 95 | 18 | – | – | 1 | 43 500 | 127 000 | 2 400 | 3 600 | **51114** |
| | 105 | 27 | 28.8 | 32 | 1 | 74 000 | 189 000 | 1 900 | 2 800 | **51214** |
| | 125 | 40 | 44.2 | 48 | 1.1 | 137 000 | 315 000 | 1 400 | 2 000 | **51314** |
| | 150 | 60 | 63.6 | 69 | 2 | 252 000 | 555 000 | 1 000 | 1 500 | **51414** |
| **75** | 100 | 19 | – | – | 1 | 43 500 | 131 000 | 2 200 | 3 400 | **51115** |
| | 110 | 27 | 28.3 | 32 | 1 | 78 000 | 209 000 | 1 800 | 2 800 | **51215** |
| | 135 | 44 | 48.1 | 52 | 1.5 | 159 000 | 365 000 | 1 300 | 1 900 | **51315** |
| | 160 | 65 | 69 | 75 | 2 | 254 000 | 560 000 | 950 | 1 400 | **51415** |
| **80** | 105 | 19 | – | – | 1 | 45 000 | 141 000 | 2 200 | 3 400 | **51116** |
| | 115 | 28 | 29.5 | 33 | 1 | 79 000 | 218 000 | 1 800 | 2 600 | **51216** |
| | 140 | 44 | 47.6 | 52 | 1.5 | 164 000 | 395 000 | 1 300 | 1 900 | **51316** |
| | 170 | 68 | 72.2 | 78 | 2.1 | 272 000 | 620 000 | 900 | 1 300 | **51416** |
| **85** | 110 | 19 | – | – | 1 | 46 500 | 150 000 | 2 200 | 3 200 | **51117** |
| | 125 | 31 | 33.1 | 37 | 1 | 96 000 | 264 000 | 1 600 | 2 400 | **51217** |
| | 150 | 49 | 53.1 | 58 | 1.5 | 207 000 | 490 000 | 1 100 | 1 700 | **51317** |
| | 180 | 72 | 77 | 83 | 2.1 | 310 000 | 755 000 | 850 | 1 300 | **51417 X** |
| **90** | 120 | 22 | – | – | 1 | 60 000 | 190 000 | 1 900 | 3 000 | **51118** |
| | 135 | 35 | 38.5 | 42 | 1.1 | 114 000 | 310 000 | 1 400 | 2 200 | **51218** |
| | 155 | 50 | 54.6 | 59 | 1.5 | 214 000 | 525 000 | 1 100 | 1 700 | **51318** |
| | 190 | 77 | 81.2 | 88 | 2.1 | 330 000 | 825 000 | 800 | 1 200 | **51418 X** |
| **100** | 135 | 25 | – | – | 1 | 86 000 | 268 000 | 1 700 | 2 600 | **51120** |
| | 150 | 38 | 40.9 | 45 | 1.1 | 135 000 | 375 000 | 1 300 | 2 000 | **51220** |
| | 170 | 55 | 59.2 | 64 | 1.5 | 239 000 | 595 000 | 1 000 | 1 500 | **51320** |
| | 210 | 85 | 90 | 98 | 3 | 370 000 | 985 000 | 710 | 1 100 | **51420 X** |

**Note** (1) The outside diameter $d_1$ of the shaft washers of all bearing numbers marked X is smaller than the outside diameter D of the housing washers.

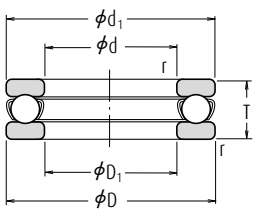


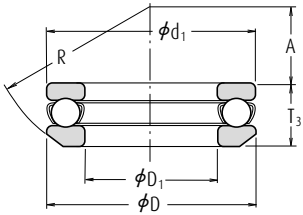




| Bearing Numbers (1) | | Dimensions (mm) | | | | | | | Abutment and Fillet Dimensions (mm) | | | Mass (kg) approx. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| With Aligning Seat | With Aligning Seat Washer | $d_1$ | $D_1$ | $D_2$ | $D_3$ | b | A | R | $d_a$ min. | $D_a$ max. | $r_a$ max. | With Flat Seat | With Aligning Seat | With Aligning Seat Washer |
| — | — | 78 | 57 | — | — | — | — | — | 69 | 64 | 0.6 | 0.227 | — | — |
| **53211** | **53211 U** | 90 | 57 | 72 | 95 | 9 | 35 | 72 | 76 | 69 | 1 | 0.599 | 0.656 | 0.819 |
| **53311** | **53311 U** | 105 | 57 | 80 | 110 | 11.5 | 30 | 80 | 85 | 75 | 1 | 1.31 | 1.45 | 1.78 |
| **53411** | **53411 U** | 120 | 57 | 88 | 125 | 15.5 | 28 | 90 | 94 | 81 | 1.5 | 2.58 | 2.59 | 3.16 |
| — | — | 85 | 62 | — | — | — | — | — | 75 | 70 | 1 | 0.281 | — | — |
| **53212** | **53212 U** | 95 | 62 | 78 | 100 | 9 | 32.5 | 72 | 81 | 74 | 1 | 0.673 | 0.731 | 0.897 |
| **53312** | **53312 U** | 110 | 62 | 85 | 115 | 11.5 | 41 | 90 | 90 | 80 | 1 | 1.4 | 1.51 | 1.83 |
| **53412** | **53412 U** | 130 | 62 | 95 | 135 | 16 | 34 | 100 | 102 | 88 | 1.5 | 3.16 | 3.2 | 3.91 |
| — | — | 90 | 67 | — | — | — | — | — | 80 | 75 | 1 | 0.324 | — | — |
| **53213** | **53213 U** | 100 | 67 | 82 | 105 | 9 | 40 | 80 | 86 | 79 | 1 | 0.756 | 0.812 | 0.989 |
| **53313** | **53313 U** | 115 | 67 | 90 | 120 | 12.5 | 38.5 | 90 | 95 | 85 | 1 | 1.54 | 1.67 | 2.04 |
| **53413** | **53413 U** | 140 | 68 | 100 | 145 | 17.5 | 40 | 112 | 110 | 95 | 2 | 4.1 | 4.22 | 5.13 |
| — | — | 95 | 72 | — | — | — | — | — | 85 | 80 | 1 | 0.346 | — | — |
| **53214** | **53214 U** | 105 | 72 | 88 | 110 | 9 | 38 | 80 | 91 | 84 | 1 | 0.793 | 0.866 | 1.05 |
| **53314** | **53314 U** | 125 | 72 | 98 | 130 | 13 | 43 | 100 | 103 | 92 | 1 | 2.0 | 2.2 | 2.64 |
| **53414** | **53414 U** | 150 | 73 | 110 | 155 | 19.5 | 34 | 112 | 118 | 102 | 2 | 5.05 | 5.12 | 6.21 |
| — | — | 100 | 77 | — | — | — | — | — | 90 | 85 | 1 | 0.389 | — | — |
| **53215** | **53215 U** | 110 | 77 | 92 | 115 | 9.5 | 49 | 90 | 96 | 89 | 1 | 0.845 | 1.27 | 1.11 |
| **53315** | **53315 U** | 135 | 77 | 105 | 140 | 15 | 37 | 100 | 111 | 99 | 1.5 | 2.6 | 2.8 | 3.42 |
| **53415** | **53415 U** | 160 | 78 | 115 | 165 | 21 | 42 | 125 | 125 | 110 | 2 | 6.15 | 6.23 | 7.58 |
| — | — | 105 | 82 | — | — | — | — | — | 95 | 90 | 1 | 0.417 | — | — |
| **53216** | **53216 U** | 115 | 82 | 98 | 120 | 10 | 46 | 90 | 101 | 94 | 1 | 0.931 | 1.01 | 1.23 |
| **53316** | **53316 U** | 140 | 82 | 110 | 145 | 15 | 50 | 112 | 116 | 104 | 1.5 | 2.74 | 2.94 | 3.55 |
| **53416** | **53416 U** | 170 | 83 | 125 | 175 | 22 | 36 | 125 | 133 | 117 | 2 | 7.21 | 7.33 | 8.9 |
| — | — | 110 | 87 | — | — | — | — | — | 100 | 95 | 1 | 0.44 | — | — |
| **53217** | **53217 U** | 125 | 88 | 105 | 130 | 11 | 52 | 100 | 109 | 101 | 1 | 1.22 | 1.35 | 1.63 |
| **53317** | **53317 U** | 150 | 88 | 115 | 155 | 17.5 | 43 | 112 | 124 | 111 | 1.5 | 3.57 | 3.78 | 4.67 |
| **53417 X** | **53417 XU** | 177 | 88 | 130 | 185 | 23 | 47 | 140 | 141 | 124 | 2 | 8.51 | 8.72 | 10.4 |
| — | — | 120 | 92 | — | — | — | — | — | 108 | 102 | 1 | 0.646 | — | — |
| **53218** | **53218 U** | 135 | 93 | 110 | 140 | 13.5 | 45 | 100 | 117 | 108 | 1 | 1.69 | 1.89 | 2.38 |
| **53318** | **53318 U** | 155 | 93 | 120 | 160 | 18 | 40 | 112 | 129 | 116 | 1.5 | 3.83 | 4.11 | 5.09 |
| **53418 X** | **53418 XU** | 187 | 93 | 140 | 195 | 25.5 | 40 | 140 | 149 | 131 | 2 | 10.2 | 10.3 | 12.4 |
| — | — | 135 | 102 | — | — | — | — | — | 121 | 114 | 1 | 0.96 | — | — |
| **53220** | **53220 U** | 150 | 103 | 125 | 155 | 14 | 52 | 112 | 130 | 120 | 1 | 2.25 | 2.49 | 3.03 |
| **53320** | **53320 U** | 170 | 103 | 135 | 175 | 18 | 46 | 125 | 142 | 128 | 1.5 | 4.98 | 5.31 | 6.37 |
| **53420 X** | **53420 XU** | 205 | 103 | 155 | 220 | 27 | 50 | 160 | 165 | 145 | 2.5 | 14.8 | 15 | 18.1 |

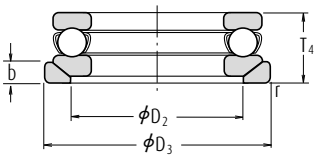
## Bore Diameter 110 – 190 mm




With Flat Seat



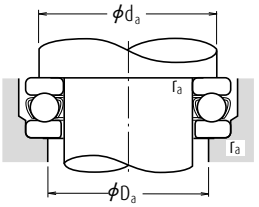

With Aligning Seat

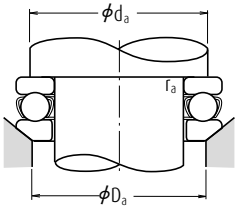


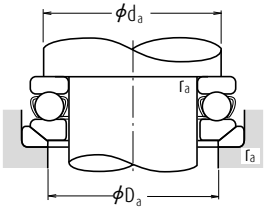

With Aligning Seat Washer

| Boundary Dimensions (mm) | | | | | | Basic Load Ratings (N) | | Limiting Speeds ($min^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| d | D | T | $T_3$ | $T_4$ | r min. | $C_a$ | $C_{0a}$ | Grease | Oil | With Flat Seat |
| **110** | 145 | 25 | – | – | 1 | 88 000 | 288 000 | 1 700 | 2 400 | **51122** |
| | 160 | 38 | 40.2 | 45 | 1.1 | 136 000 | 395 000 | 1 300 | 1 900 | **51222** |
| | 190 | 63 | 67.2 | 72 | 2 | 282 000 | 755 000 | 900 | 1 300 | **51322 X** |
| | 230 | 95 | 99.7 | 109 | 3 | 415 000 | 1 150 000 | 630 | 950 | **51422 X** |
| **120** | 155 | 25 | – | – | 1 | 90 000 | 310 000 | 1 600 | 2 400 | **51124** |
| | 170 | 39 | 40.8 | 46 | 1.1 | 141 000 | 430 000 | 1 200 | 1 800 | **51224** |
| | 210 | 70 | 74.1 | 80 | 2.1 | 330 000 | 930 000 | 800 | 1 200 | **51324 X** |
| | 250 | 102 | 107.3 | 118 | 4 | 480 000 | 1 400 000 | 600 | 900 | **51424 X** |
| **130** | 170 | 30 | – | – | 1 | 105 000 | 350 000 | 1 400 | 2 000 | **51126** |
| | 190 | 45 | 47.9 | 53 | 1.5 | 183 000 | 550 000 | 1 100 | 1 600 | **51226 X** |
| | 225 | 75 | 80.3 | 86 | 2.1 | 350 000 | 1 030 000 | 750 | 1 100 | **51326 X** |
| | 270 | 110 | 115.2 | 128 | 4 | 525 000 | 1 590 000 | 530 | 800 | **51426 X** |
| **140** | 180 | 31 | – | – | 1 | 107 000 | 375 000 | 1 300 | 2 000 | **51128 X** |
| | 200 | 46 | 48.6 | 55 | 1.5 | 186 000 | 575 000 | 1 000 | 1 500 | **51228 X** |
| | 240 | 80 | 84.9 | 92 | 2.1 | 370 000 | 1 130 000 | 670 | 1 000 | **51328 X** |
| | 280 | 112 | 117 | 131 | 4 | 550 000 | 1 750 000 | 530 | 800 | **51428 X** |
| **150** | 190 | 31 | – | – | 1 | 110 000 | 400 000 | 1 300 | 1 900 | **51130 X** |
| | 215 | 50 | 53.3 | 60 | 1.5 | 238 000 | 735 000 | 950 | 1 400 | **51230 X** |
| | 250 | 80 | 83.7 | 92 | 2.1 | 380 000 | 1 200 000 | 670 | 1 000 | **51330 X** |
| | 300 | 120 | 125.9 | 140 | 4 | 620 000 | 2 010 000 | 480 | 710 | **51430 X** |
| **160** | 200 | 31 | – | – | 1 | 113 000 | 425 000 | 1 200 | 1 900 | **51132 X** |
| | 225 | 51 | 54.7 | 61 | 1.5 | 249 000 | 805 000 | 900 | 1 400 | **51232 X** |
| | 270 | 87 | 91.7 | 100 | 3 | 475 000 | 1 570 000 | 600 | 900 | **51332 X** |
| | 320 | 130 | 135.3 | 150 | 5 | 650 000 | 2 210 000 | 450 | 670 | **51432 X** |
| **170** | 215 | 34 | – | – | 1.1 | 135 000 | 510 000 | 1 100 | 1 700 | **51134 X** |
| | 240 | 55 | 58.7 | 65 | 1.5 | 280 000 | 915 000 | 850 | 1 300 | **51234 X** |
| | 280 | 87 | 91.3 | 100 | 3 | 465 000 | 1 570 000 | 600 | 900 | **51334 X** |
| | 340 | 135 | 141 | 156 | 5 | 715 000 | 2 480 000 | 430 | 630 | **51434 X** |
| **180** | 225 | 34 | – | – | 1.1 | 136 000 | 530 000 | 1 100 | 1 700 | **51136 X** |
| | 250 | 56 | 58.2 | 66 | 1.5 | 284 000 | 955 000 | 800 | 1 200 | **51236 X** |
| | 300 | 95 | 99.3 | 109 | 3 | 480 000 | 1 680 000 | 560 | 850 | **51336 X** |
| | 360 | 140 | 148.3 | 164 | 5 | 750 000 | 2 730 000 | 400 | 600 | **51436 X** |
| **190** | 240 | 37 | – | – | 1.1 | 172 000 | 655 000 | 1 000 | 1 600 | **51138 X** |
| | 270 | 62 | 65.7 | 73 | 2 | 320 000 | 1 110 000 | 750 | 1 100 | **51238 X** |
| | 320 | 105 | 111 | 121 | 4 | 550 000 | 1 960 000 | 500 | 750 | **51338 X** |

**Note** (1) The outside diameter $d_1$ of the shaft washers of all bearing numbers marked X is smaller than the outside diameter D of the housing washers.

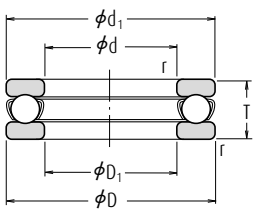


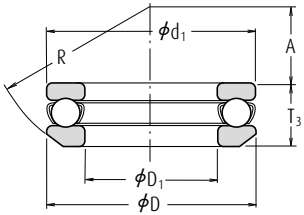




| Bearing Numbers (1) | | Dimensions (mm) | | | | | | | Abutment and Fillet Dimensions (mm) | | | Mass (kg) approx. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| With Aligning Seat | With Aligning Seat Washer | $d_1$ | $D_1$ | $D_2$ | $D_3$ | b | A | R | $d_a$ min. | $D_a$ max. | $r_a$ max. | With Flat Seat | With Aligning Seat | With Aligning Seat Washer |
| — | — | 145 | 112 | — | — | — | — | — | 131 | 124 | 1 | 1.04 | — | — |
| **53222** | **53222 U** | 160 | 113 | 135 | 165 | 14 | 65 | 125 | 140 | 130 | 1 | 2.42 | 2.65 | 3.2 |
| **53322 X** | **53322 XU** | 187 | 113 | 150 | 195 | 20.5 | 51 | 140 | 158 | 142 | 2 | 7.19 | 7.55 | 9.1 |
| **53422 X** | **53422 XU** | 225 | 113 | 170 | 240 | 29 | 59 | 180 | 181 | 159 | 2.5 | 20 | 20.5 | 24.3 |
| — | — | 155 | 122 | — | — | — | — | — | 141 | 134 | 1 | 1.12 | — | — |
| **53224** | **53224 U** | 170 | 123 | 145 | 175 | 15 | 61 | 125 | 150 | 140 | 1 | 2.7 | 2.94 | 3.58 |
| **53324 X** | **53324 XU** | 205 | 123 | 165 | 220 | 22 | 63 | 160 | 173 | 157 | 2 | 9.7 | 10.1 | 12.4 |
| **53424 X** | **53424 XU** | 245 | 123 | 185 | 260 | 32 | 70 | 200 | 196 | 174 | 3 | 26.2 | 26.5 | 31.3 |
| — | — | 170 | 132 | — | — | — | — | — | 154 | 146 | 1 | 1.68 | — | — |
| **53226 X** | **53226 XU** | 187 | 133 | 160 | 195 | 17 | 67 | 140 | 166 | 154 | 1.5 | 3.95 | 4.35 | 5.33 |
| **53326 X** | **53326 XU** | 220 | 134 | 177 | 235 | 26 | 53 | 160 | 186 | 169 | 2 | 12.1 | 12.7 | 15.8 |
| **53426 X** | **53426 XU** | 265 | 134 | 200 | 280 | 38 | 58 | 200 | 212 | 188 | 3 | 32.3 | 32.4 | 38.8 |
| — | — | 178 | 142 | — | — | — | — | — | 164 | 156 | 1 | 1.83 | — | — |
| **53228 X** | **53228 XU** | 197 | 143 | 170 | 210 | 17 | 87 | 160 | 176 | 164 | 1.5 | 4.3 | 4.74 | 5.89 |
| **53328 X** | **53328 XU** | 235 | 144 | 190 | 250 | 26 | 68 | 180 | 199 | 181 | 2 | 14.2 | 16.3 | 19.5 |
| **53428 X** | **53428 XU** | 275 | 144 | 206 | 290 | 38 | 83 | 225 | 222 | 198 | 3 | 34.7 | 34.8 | 41.4 |
| — | — | 188 | 152 | — | — | — | — | — | 174 | 166 | 1 | 1.95 | — | — |
| **53230 X** | **53230 XU** | 212 | 153 | 180 | 225 | 20.5 | 79 | 160 | 189 | 176 | 1.5 | 5.52 | 6.09 | 7.82 |
| **53330 X** | **53330 XU** | 245 | 154 | 200 | 260 | 26 | 89.5 | 200 | 209 | 191 | 2 | 15 | 17.3 | 20.5 |
| **53430 X** | **53430 XU** | 295 | 154 | 225 | 310 | 41 | 69 | 225 | 238 | 212 | 3 | 43.5 | 43.8 | 51.9 |
| — | — | 198 | 162 | — | — | — | — | — | 184 | 176 | 1 | 2.07 | — | — |
| **53232 X** | **53232 XU** | 222 | 163 | 190 | 235 | 21 | 74 | 160 | 199 | 186 | 1.5 | 6.04 | 6.78 | 8.7 |
| **53332 X** | **53332 XU** | 265 | 164 | 215 | 280 | 29 | 77 | 200 | 225 | 205 | 2.5 | 19.6 | 22.3 | 26.7 |
| **53432 X** | **53432 XU** | 315 | 164 | 240 | 330 | 41.5 | 84 | 250 | 254 | 226 | 4 | 52.7 | 52.9 | 62 |
| — | — | 213 | 172 | — | — | — | — | — | 197 | 188 | 1 | 2.72 | — | — |
| **53234 X** | **53234 XU** | 237 | 173 | 200 | 250 | 21.5 | 91 | 180 | 212 | 198 | 1.5 | 7.41 | 8.21 | 10.5 |
| **53334 X** | **53334 XU** | 275 | 174 | 220 | 290 | 29 | 105 | 225 | 235 | 215 | 2.5 | 20.3 | 23.2 | 28 |
| **53434 X** | **53434 XU** | 335 | 174 | 255 | 350 | 46 | 74 | 250 | 269 | 241 | 4 | 61.2 | 61.3 | 73 |
| — | — | 222 | 183 | — | — | — | — | — | 207 | 198 | 1 | 2.79 | — | — |
| **53236 X** | **53236 XU** | 247 | 183 | 210 | 260 | 21.5 | 112 | 200 | 222 | 208 | 1.5 | 7.94 | 8.57 | 10.8 |
| **53336 X** | **53336 XU** | 295 | 184 | 240 | 310 | 32 | 91 | 225 | 251 | 229 | 2.5 | 25.9 | 29.2 | 34.9 |
| **53436 X** | **53436 XU** | 355 | 184 | 270 | 370 | 46.5 | 97 | 280 | 285 | 255 | 4 | 70.5 | 72.1 | 84.9 |
| — | — | 237 | 193 | — | — | — | — | — | 220 | 210 | 1 | 3.6 | — | — |
| **53238 X** | **53238 XU** | 267 | 194 | 230 | 280 | 23 | 98 | 200 | 238 | 222 | 2 | 11.8 | 12.9 | 15.7 |
| **53338 X** | **53338 XU** | 315 | 195 | 255 | 330 | 33 | 104 | 250 | 266 | 244 | 3 | 36.5 | 38.1 | 44.7 |

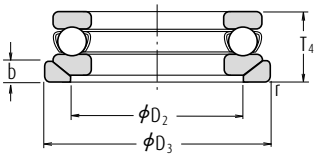
## Bore Diameter 200 – 360 mm




With Flat Seat



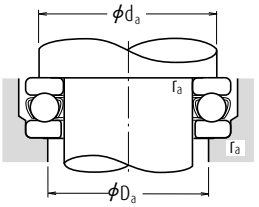

With Aligning Seat

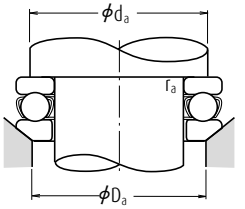


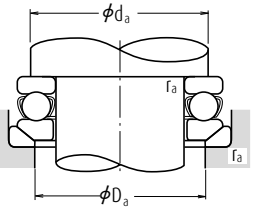

With Aligning Seat Washer

| Boundary Dimensions (mm) | | | | | | Basic Load Ratings (N) | | Limiting Speeds ($min^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| d | D | T | $T_3$ | $T_4$ | r min. | $C_a$ | $C_{0a}$ | Grease | Oil | With Flat Seat |
| **200** | 250 | 37 | – | – | 1.1 | 173 000 | 675 000 | 1 000 | 1 500 | **51140 X** |
| | 280 | 62 | 65.3 | 74 | 2 | 315 000 | 1 110 000 | 710 | 1 100 | **51240 X** |
| | 340 | 110 | 118.4 | 130 | 4 | 600 000 | 2 220 000 | 480 | 710 | **51340 X** |
| **220** | 270 | 37 | – | – | 1.1 | 179 000 | 740 000 | 950 | 1 500 | **51144 X** |
| | 300 | 63 | 65.6 | 75 | 2 | 325 000 | 1 210 000 | 670 | 1 000 | **51244 X** |
| **240** | 300 | 45 | – | – | 1.5 | 229 000 | 935 000 | 850 | 1 200 | **51148 X** |
| | 340 | 78 | 81.6 | 92 | 2.1 | 420 000 | 1 650 000 | 560 | 850 | **51248 X** |
| **260** | 320 | 45 | – | – | 1.5 | 233 000 | 990 000 | 800 | 1 200 | **51152 X** |
| | 360 | 79 | 82.8 | 93 | 2.1 | 435 000 | 1 800 000 | 560 | 850 | **51252 X** |
| **280** | 350 | 53 | – | – | 1.5 | 315 000 | 1 310 000 | 710 | 1 000 | **51156 X** |
| | 380 | 80 | 85 | 94 | 2.1 | 450 000 | 1 950 000 | 530 | 800 | **51256 X** |
| **300** | 380 | 62 | – | – | 2 | 360 000 | 1 560 000 | 600 | 900 | **51160 X** |
| | 420 | 95 | 100.5 | 112 | 3 | 540 000 | 2 410 000 | 450 | 670 | **51260 X** |
| **320** | 400 | 63 | – | – | 2 | 365 000 | 1 660 000 | 600 | 900 | **51164 X** |
| | 440 | 95 | 100.5 | 112 | 3 | 585 000 | 2 680 000 | 450 | 670 | **51264 X** |
| **340** | 420 | 64 | – | – | 2 | 375 000 | 1 760 000 | 560 | 850 | **51168 X** |
| | 460 | 96 | 100.3 | 113 | 3 | 595 000 | 2 800 000 | 430 | 630 | **51268 X** |
| **360** | 440 | 65 | – | – | 2 | 385 000 | 1 860 000 | 560 | 800 | **51172 X** |
| | 500 | 110 | 116.7 | 130 | 4 | 705 000 | 3 500 000 | 380 | 560 | **51272 X** |

**Note** (1) The outside diameter $d_1$ of the shaft washers of all bearing numbers marked X is smaller than the outside diameter D of the housing washers.



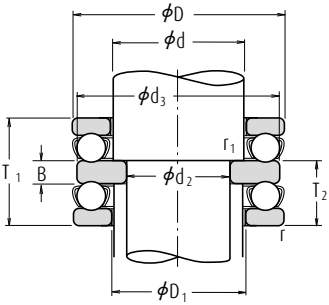



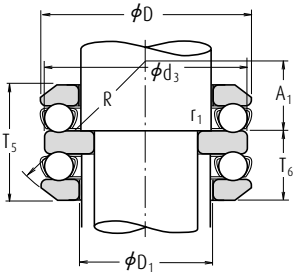

| Bearing Numbers (1) | | Dimensions (mm) | | | | | | | Abutment and Fillet Dimensions (mm) | | | Mass (kg) approx. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| With Aligning Seat | With Aligning Seat Washer | $d_1$ | $D_1$ | $D_2$ | $D_3$ | b | A | R | $d_a$ min. | $D_a$ max. | $r_a$ max. | With Flat Seat | With Aligning Seat | With Aligning Seat Washer |
| — | — | 247 | 203 | — | — | — | — | — | 230 | 220 | 1 | 3.75 | — | — |
| **53240 X** | **53240 XU** | 277 | 204 | 240 | 290 | 23 | 125 | 225 | 248 | 232 | 2 | 12.3 | 13.4 | 16.1 |
| **53340 X** | **53340 XU** | 335 | 205 | 270 | 350 | 38 | 92 | 250 | 282 | 258 | 3 | 43.6 | 46.2 | 54.8 |
| — | — | 267 | 223 | — | — | — | — | — | 250 | 240 | 1 | 4.09 | — | — |
| **53244 X** | **53244 XU** | 297 | 224 | 260 | 310 | 25 | 118 | 225 | 268 | 252 | 2 | 13.6 | 14.9 | 18 |
| — | — | 297 | 243 | — | — | — | — | — | 276 | 264 | 1.5 | 6.55 | — | — |
| **53248 X** | **53248 XU** | 335 | 244 | 290 | 350 | 30 | 122 | 250 | 299 | 281 | 2 | 23.7 | 25.6 | 30.7 |
| — | — | 317 | 263 | — | — | — | — | — | 296 | 284 | 1.5 | 7.01 | — | — |
| **53252 X** | **53252 XU** | 355 | 264 | 305 | 370 | 30 | 152 | 280 | 319 | 301 | 2 | 25.1 | 27.3 | 33.2 |
| — | — | 347 | 283 | — | — | — | — | — | 322 | 308 | 1.5 | 12 | — | — |
| **53256 X** | **53256 XU** | 375 | 284 | 325 | 390 | 31 | 143 | 280 | 339 | 321 | 2 | 27.1 | 30.3 | 37 |
| — | — | 376 | 304 | — | — | — | — | — | 348 | 332 | 2 | 17.2 | — | — |
| **53260 X** | **53260 XU** | 415 | 304 | 360 | 430 | 34 | 164 | 320 | 371 | 349 | 2.5 | 43.5 | 47.7 | 56.1 |
| — | — | 396 | 324 | — | — | — | — | — | 368 | 352 | 2 | 18.6 | — | — |
| **53264 X** | **53264 XU** | 435 | 325 | 380 | 450 | 36 | 157 | 320 | 391 | 369 | 2.5 | 45 | 49.9 | 59.4 |
| — | — | 416 | 344 | — | — | — | — | — | 388 | 372 | 2 | 19.9 | — | — |
| **53268 X** | **53268 XU** | 455 | 345 | 400 | 470 | 36 | 199 | 360 | 411 | 389 | 2.5 | 47.9 | 52.7 | 62 |
| — | — | 436 | 364 | — | — | — | — | — | 408 | 392 | 2 | 21.5 | — | — |
| **53272 X** | **53272 XU** | 495 | 365 | 430 | 510 | 43 | 172 | 360 | 442 | 418 | 3 | 68.8 | 76.3 | 90.9 |

# Double-Direction Thrust Ball Bearings

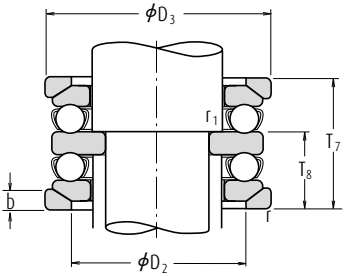
## Bore Diameter 10 – 55 mm




With Flat Seat

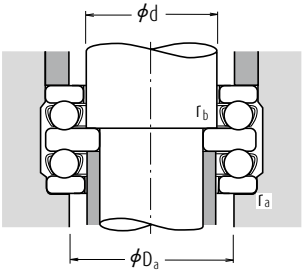


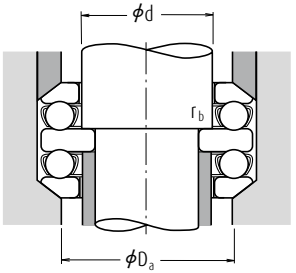

With Aligning Seat

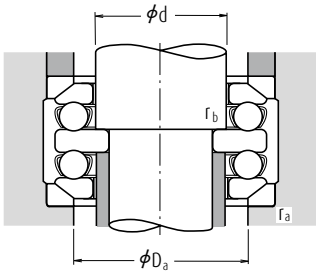



With Aligning Seat Washer

| Boundary Dimensions (mm) | | | | | | | | Basic Load Ratings (N) | | Limiting Speeds (min$^{-1}$) | | Bearing Numbers | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $d_2$ | d | D | $T_1$ | $T_5$ | $T_7$ | r min. | $r_1$ min. | $C_a$ | $C_{0a}$ | Grease | Oil | With Flat Seat | With Aligning Seat |
| **10** | 15 | 32 | 22 | 24.6 | 28 | 0.6 | 0.3 | 16 700 | 24 800 | 4 800 | 7 100 | **52202** | **54202** |
| **15** | 20 | 40 | 26 | 27.4 | 32 | 0.6 | 0.3 | 22 500 | 37 500 | 4 000 | 6 000 | **52204** | **54204** |
| | 25 | 60 | 45 | 49.8 | 55 | 1 | 0.6 | 56 000 | 89 500 | 2 400 | 3 600 | **52405** | **54405** |
| **20** | 25 | 47 | 28 | 31.4 | 36 | 0.6 | 0.3 | 28 000 | 50 500 | 3 400 | 5 300 | **52205** | **54205** |
| | 25 | 52 | 34 | 37.6 | 42 | 1 | 0.3 | 36 000 | 61 500 | 3 000 | 4 500 | **52305** | **54305** |
| | 30 | 70 | 52 | 56.2 | 62 | 1 | 0.6 | 73 000 | 126 000 | 2 200 | 3 200 | **52406** | **54406** |
| **25** | 30 | 52 | 29 | 32.6 | 37 | 0.6 | 0.3 | 29 500 | 58 000 | 3 200 | 5 000 | **52206** | **54206** |
| | 30 | 60 | 38 | 41.2 | 46 | 1 | 0.3 | 43 000 | 78 500 | 2 600 | 4 000 | **52306** | **54306** |
| | 35 | 80 | 59 | 63 | 69 | 1.1 | 0.6 | 87 500 | 155 000 | 1 800 | 2 800 | **52407** | **54407** |
| **30** | 35 | 62 | 34 | 37.8 | 42 | 1 | 0.3 | 39 500 | 78 000 | 2 800 | 4 300 | **52207** | **54207** |
| | 35 | 68 | 44 | 47.2 | 52 | 1 | 0.3 | 56 000 | 105 000 | 2 400 | 3 600 | **52307** | **54307** |
| | 40 | 68 | 36 | 38.6 | 44 | 1 | 0.6 | 47 500 | 98 500 | 2 600 | 3 800 | **52208** | **54208** |
| | 40 | 78 | 49 | 54 | 59 | 1 | 0.6 | 70 000 | 135 000 | 2 000 | 3 000 | **52308** | **54308** |
| | 40 | 90 | 65 | 69.4 | 77 | 1.1 | 0.6 | 103 000 | 188 000 | 1 700 | 2 400 | **52408** | **54408** |
| **35** | 45 | 73 | 37 | 39.6 | 45 | 1 | 0.6 | 48 000 | 105 000 | 2 400 | 3 600 | **52209** | **54209** |
| | 45 | 85 | 52 | 56.2 | 62 | 1 | 0.6 | 80 500 | 163 000 | 1 900 | 2 800 | **52309** | **54309** |
| | 45 | 100 | 72 | 78.8 | 86 | 1.1 | 0.6 | 128 000 | 246 000 | 1 500 | 2 200 | **52409** | **54409** |
| **40** | 50 | 78 | 39 | 42 | 47 | 1 | 0.6 | 49 000 | 111 000 | 2 400 | 3 400 | **52210** | **54210** |
| | 50 | 95 | 58 | 64.6 | 70 | 1.1 | 0.6 | 97 500 | 202 000 | 1 700 | 2 600 | **52310** | **54310** |
| | 50 | 110 | 78 | 83.2 | 92 | 1.5 | 0.6 | 147 000 | 288 000 | 1 400 | 2 000 | **52410** | **54410** |
| **45** | 55 | 90 | 45 | 49.6 | 55 | 1 | 0.6 | 70 000 | 159 000 | 2 000 | 3 000 | **52211** | **54211** |
| | 55 | 105 | 64 | 72.6 | 78 | 1.1 | 0.6 | 115 000 | 244 000 | 1 500 | 2 400 | **52311** | **54311** |
| | 55 | 120 | 87 | 92 | 101 | 1.5 | 0.6 | 181 000 | 350 000 | 1 200 | 1 800 | **52411** | **54411** |
| **50** | 60 | 95 | 46 | 50 | 56 | 1 | 0.6 | 71 500 | 169 000 | 1 900 | 3 000 | **52212** | **54212** |
| | 60 | 110 | 64 | 70.6 | 78 | 1.1 | 0.6 | 119 000 | 263 000 | 1 500 | 2 200 | **52312** | **54312** |
| | 60 | 130 | 93 | 99 | 107 | 1.5 | 0.6 | 202 000 | 395 000 | 1 100 | 1 700 | **52412** | **54412** |
| | 65 | 140 | 101 | 109.4 | 119 | 2 | 1 | 234 000 | 495 000 | 1 000 | 1 600 | **52413** | **54413** |
| **55** | 65 | 100 | 47 | 50.4 | 57 | 1 | 0.6 | 75 500 | 189 000 | 1 900 | 2 800 | **52213** | **54213** |
| | 65 | 115 | 65 | 71.8 | 79 | 1.1 | 0.6 | 123 000 | 282 000 | 1 500 | 2 200 | **52313** | **54313** |
| | 70 | 105 | 47 | 50.6 | 57 | 1 | 1 | 74 000 | 189 000 | 1 800 | 2 800 | **52214** | **54214** |
| | 70 | 125 | 72 | 80.4 | 88 | 1.1 | 1 | 137 000 | 315 000 | 1 300 | 2 000 | **52314** | **54314** |
| | 70 | 150 | 107 | 114.2 | 125 | 2 | 1 | 252 000 | 555 000 | 1 000 | 1 500 | **52414** | **54414** |



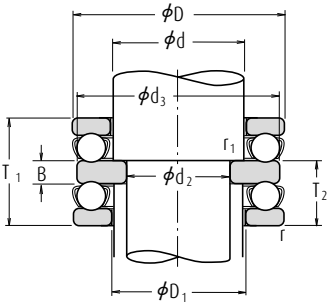



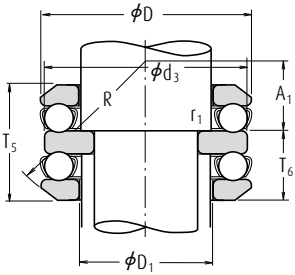

| With Aligning Seat Washer | Dimensions (mm) | | | | | | | | | | | Abutment and Fillet Dimensions (mm) | | | Mass (kg) approx. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $d_3$ | $D_1$ | $D_2$ | $D_3$ | $T_2$ | $T_6$ | $T_8$ | B | b | $A_1$ | R | $D_a$ max. | $r_a$ max. | $r_b$ max. | With Flat Seat | With Aligning Seat | With Aligning Seat Washer |
| **54202 U** | 32 | 17 | 24 | 35 | 13.5 | 14.8 | 16.5 | 5 | 4 | 10.5 | 28 | 24 | 0.6 | 0.3 | 0.081 | 0.090 | 0.113 |
| **54204 U** | 40 | 22 | 30 | 42 | 16 | 16.7 | 19 | 6 | 5 | 16 | 36 | 30 | 0.6 | 0.3 | 0.148 | 0.151 | 0.185 |
| **54405 U** | 60 | 27 | 42 | 62 | 28 | 30.4 | 33 | 11 | 8 | 15 | 50 | 42 | 1 | 0.6 | 0.641 | 0.68 | 0.825 |
| **54205 U** | 47 | 27 | 36 | 50 | 17.5 | 19.2 | 21.5 | 7 | 5.5 | 16.5 | 40 | 36 | 0.6 | 0.3 | 0.213 | 0.236 | 0.293 |
| **54305 U** | 52 | 27 | 38 | 55 | 21 | 22.8 | 25 | 8 | 6 | 18 | 45 | 38 | 1 | 0.3 | 0.324 | 0.35 | 0.434 |
| **54406 U** | 70 | 32 | 50 | 75 | 32 | 34.1 | 37 | 12 | 9 | 16 | 56 | 50 | 1 | 0.6 | 0.978 | 1.01 | 1.27 |
| **54206 U** | 52 | 32 | 42 | 55 | 18 | 19.8 | 22 | 7 | 5.5 | 20 | 45 | 42 | 0.6 | 0.3 | 0.254 | 0.288 | 0.345 |
| **54306 U** | 60 | 32 | 45 | 62 | 23.5 | 25.1 | 27.5 | 9 | 7 | 19.5 | 50 | 45 | 1 | 0.3 | 0.483 | 0.511 | 0.621 |
| **54407 U** | 80 | 37 | 58 | 85 | 36.5 | 38.5 | 41.5 | 14 | 10 | 18.5 | 64 | 58 | 1 | 0.6 | 1.43 | 1.47 | 1.83 |
| **54207 U** | 62 | 37 | 48 | 65 | 21 | 22.9 | 25 | 8 | 7 | 21 | 50 | 48 | 1 | 0.3 | 0.406 | 0.447 | 0.57 |
| **54307 U** | 68 | 37 | 52 | 72 | 27 | 28.6 | 31 | 10 | 7.5 | 21 | 56 | 52 | 1 | 0.3 | 0.71 | 0.744 | 0.915 |
| **54208 U** | 68 | 42 | 55 | 72 | 22.5 | 23.8 | 26.5 | 9 | 7 | 25 | 56 | 55 | 1 | 0.6 | 0.543 | 0.581 | 0.713 |
| **54308 U** | 78 | 42 | 60 | 82 | 30.5 | 33 | 35.5 | 12 | 8.5 | 23.5 | 64 | 60 | 1 | 0.6 | 1.04 | 1.13 | 1.38 |
| **54408 U** | 90 | 42 | 65 | 95 | 40 | 42.2 | 46 | 15 | 12 | 22 | 72 | 65 | 1 | 0.6 | 1.98 | 2.02 | 2.54 |
| **54209 U** | 73 | 47 | 60 | 78 | 23 | 24.3 | 27 | 9 | 7.5 | 23 | 56 | 60 | 1 | 0.6 | 0.606 | 0.652 | 0.823 |
| **54309 U** | 85 | 47 | 65 | 90 | 32 | 34.1 | 37 | 12 | 10 | 21 | 64 | 65 | 1 | 0.6 | 1.28 | 1.34 | 1.71 |
| **54409 U** | 100 | 47 | 72 | 105 | 44.5 | 47.9 | 51.5 | 17 | 12.5 | 23.5 | 80 | 72 | 1 | 0.6 | 2.71 | 2.85 | 3.53 |
| **54210 U** | 78 | 52 | 62 | 82 | 24 | 25.5 | 28 | 9 | 7.5 | 30.5 | 64 | 62 | 1 | 0.6 | 0.697 | 0.75 | 0.949 |
| **54310 U** | 95 | 52 | 72 | 100 | 36 | 39.3 | 42 | 14 | 11 | 23 | 72 | 72 | 1 | 0.6 | 1.78 | 1.94 | 2.46 |
| **54410 U** | 110 | 52 | 80 | 115 | 48 | 50.6 | 55 | 18 | 14 | 30 | 90 | 80 | 1.5 | 0.6 | 3.51 | 3.59 | 4.45 |
| **54211 U** | 90 | 57 | 72 | 95 | 27.5 | 29.8 | 32.5 | 10 | 9 | 32.5 | 72 | 72 | 1 | 0.6 | 1.11 | 1.22 | 1.55 |
| **54311 U** | 105 | 57 | 80 | 110 | 39.5 | 43.8 | 46.5 | 15 | 11.5 | 25.5 | 80 | 80 | 1 | 0.6 | 2.43 | 2.7 | 3.35 |
| **54411 U** | 120 | 57 | 88 | 125 | 53.5 | 56 | 60.5 | 20 | 15.5 | 22.5 | 90 | 88 | 1.5 | 0.6 | 4.66 | 4.68 | 5.82 |
| **54212 U** | 95 | 62 | 78 | 100 | 28 | 30 | 33 | 10 | 9 | 30.5 | 72 | 78 | 1 | 0.6 | 1.22 | 1.33 | 1.66 |
| **54312 U** | 110 | 62 | 85 | 115 | 39.5 | 42.8 | 46.5 | 15 | 11.5 | 36.5 | 90 | 85 | 1 | 0.6 | 2.59 | 2.82 | 3.45 |
| **54412 U** | 130 | 62 | 95 | 135 | 57 | 60 | 64 | 21 | 16 | 28 | 100 | 95 | 1.5 | 0.6 | 5.74 | 5.82 | 7.24 |
| **54413 U** | 140 | 68 | 100 | 145 | 62 | 66.2 | 71 | 23 | 17.5 | 34 | 112 | 100 | 2 | 1 | 7.41 | 7.66 | 9.47 |
| **54213 U** | 100 | 67 | 82 | 105 | 28.5 | 30.2 | 33.5 | 10 | 9 | 38.5 | 80 | 82 | 1 | 0.6 | 1.34 | 1.45 | 1.81 |
| **54313 U** | 115 | 67 | 90 | 120 | 40 | 43.4 | 47 | 15 | 12.5 | 34.5 | 90 | 90 | 1 | 0.6 | 2.8 | 3.06 | 3.8 |
| **54214 U** | 105 | 72 | 88 | 110 | 28.5 | 30.3 | 33.5 | 10 | 9 | 36.5 | 80 | 88 | 1 | 1 | 1.44 | 1.59 | 1.95 |
| **54314 U** | 125 | 72 | 98 | 130 | 44 | 48.2 | 52 | 16 | 13 | 39 | 100 | 98 | 1 | 1 | 3.67 | 4.07 | 4.95 |
| **54414 U** | 150 | 73 | 110 | 155 | 65.5 | 69.1 | 74.5 | 24 | 19.5 | 28.5 | 112 | 110 | 2 | 1 | 8.99 | 9.12 | 11.3 |

# Double-Direction Thrust Ball Bearings

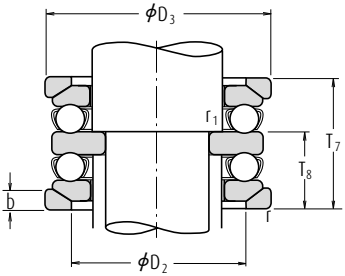
## Bore Diameter 60 – 130 mm




With Flat Seat



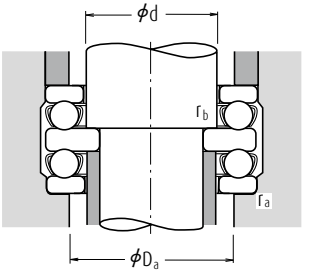

With Aligning Seat

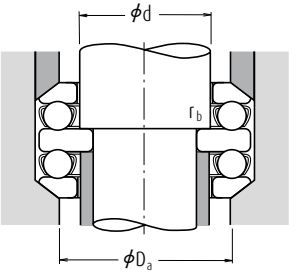


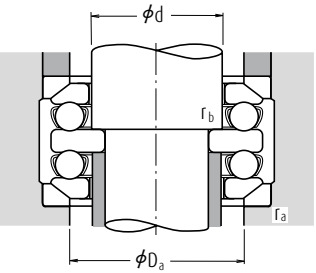

With Aligning Seat Washer

| Boundary Dimensions (mm) | | | | | | | | Basic Load Ratings (N) | | Limiting Speeds (min$^{-1}$) | | Bearing Numbers [1] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $d_2$ | d | D | $T_1$ | $T_5$ | $T_7$ | r min. | $r_1$ min. | $C_a$ | $C_{0a}$ | Grease | Oil | With Flat Seat | With Aligning Seat |
| **60** | 75 | 110 | 47 | 49.6 | 57 | 1 | 1 | 78 000 | 209 000 | 1 800 | 2 600 | **52215** | **54215** |
| | 75 | 135 | 79 | 87.2 | 95 | 1.5 | 1 | 159 000 | 365 000 | 1 200 | 1 800 | **52315** | **54315** |
| | 75 | 160 | 115 | 123 | 135 | 2 | 1 | 254 000 | 560 000 | 900 | 1 400 | **52415** | **54415** |
| **65** | 80 | 115 | 48 | 51 | 58 | 1 | 1 | 79 000 | 218 000 | 1 700 | 2 600 | **52216** | **54216** |
| | 80 | 140 | 79 | 86.2 | 95 | 1.5 | 1 | 164 000 | 395 000 | 1 200 | 1 800 | **52316** | **54316** |
| | 80 | 170 | 120 | 128.4 | 140 | 2.1 | 1 | 272 000 | 620 000 | 850 | 1 300 | **52416** | **54416** |
| | 85 | 180 | 128 | 138 | 150 | 2.1 | 1.1 | 310 000 | 755 000 | 800 | 1 200 | **52417 X** | **54417 X** |
| **70** | 85 | 125 | 55 | 59.2 | 67 | 1 | 1 | 96 000 | 264 000 | 1 500 | 2 200 | **52217** | **54217** |
| | 85 | 150 | 87 | 95.2 | 105 | 1.5 | 1 | 207 000 | 490 000 | 1 100 | 1 600 | **52317** | **54317** |
| | 90 | 190 | 135 | 143.4 | 157 | 2.1 | 1.1 | 330 000 | 825 000 | 750 | 1 100 | **52418 X** | **54418 X** |
| **75** | 90 | 135 | 62 | 69 | 76 | 1.1 | 1 | 114 000 | 310 000 | 1 400 | 2 000 | **52218** | **54218** |
| | 90 | 155 | 88 | 97.2 | 106 | 1.5 | 1 | 214 000 | 525 000 | 1 100 | 1 600 | **52318** | **54318** |
| **80** | 100 | 210 | 150 | 160 | 176 | 3 | 1.1 | 370 000 | 985 000 | 670 | 1 000 | **52420 X** | **54420 X** |
| **85** | 100 | 150 | 67 | 72.8 | 81 | 1.1 | 1 | 135 000 | 375 000 | 1 300 | 1 900 | **52220** | **54220** |
| | 100 | 170 | 97 | 105.4 | 115 | 1.5 | 1 | 239 000 | 595 000 | 950 | 1 500 | **52320** | **54320** |
| **90** | 110 | 230 | 166 | — | — | 3 | 1.1 | 415 000 | 1 150 000 | 600 | 900 | **52422 X** | — |
| **95** | 110 | 160 | 67 | 71.4 | 81 | 1.1 | 1 | 136 000 | 395 000 | 1 200 | 1 800 | **52222** | **54222** |
| | 110 | 190 | 110 | 118.4 | 128 | 2 | 1 | 282 000 | 755 000 | 850 | 1 300 | **52322 X** | **54322 X** |
| | 120 | 250 | 177 | — | — | 4 | 1.5 | 515 000 | 1 540 000 | 560 | 850 | **52424 X** | — |
| **100** | 120 | 170 | 68 | 71.6 | 82 | 1.1 | 1.1 | 141 000 | 430 000 | 1 200 | 1 800 | **52224** | **54224** |
| | 120 | 210 | 123 | 131.2 | 143 | 2.1 | 1.1 | 330 000 | 930 000 | 750 | 1 100 | **52324 X** | **54324 X** |
| | 130 | 270 | 192 | — | — | 4 | 1.5 | 525 000 | 1 590 000 | 530 | 800 | **52426 X** | — |
| **110** | 130 | 190 | 80 | 85.8 | 96 | 1.5 | 1.1 | 183 000 | 550 000 | 1 000 | 1 500 | **52226 X** | **54226 X** |
| | 130 | 225 | 130 | — | — | 2.1 | 1.1 | 350 000 | 1 030 000 | 710 | 1 100 | **52326 X** | — |
| | 140 | 280 | 196 | — | — | 4 | 1.5 | 550 000 | 1 750 000 | 500 | 750 | **52428 X** | — |
| **120** | 140 | 200 | 81 | 86.2 | 99 | 1.5 | 1.1 | 186 000 | 575 000 | 1 000 | 1 500 | **52228 X** | **54228 X** |
| | 140 | 240 | 140 | — | — | 2.1 | 1.1 | 370 000 | 1 130 000 | 670 | 1 000 | **52328 X** | — |
| | 150 | 300 | 209 | — | — | 4 | 2 | 620 000 | 2 010 000 | 480 | 710 | **52430 X** | — |
| **130** | 150 | 215 | 89 | 95.6 | 109 | 1.5 | 1.1 | 238 000 | 735 000 | 900 | 1 300 | **52230 X** | **54230 X** |
| | 150 | 250 | 140 | — | — | 2.1 | 1.1 | 380 000 | 1 200 000 | 630 | 950 | **52330 X** | — |
| | 160 | 320 | 226 | — | — | 5 | 2 | 650 000 | 2 210 000 | 430 | 630 | **52432 X** | — |

**Note** [1] The outside diameter $d_3$ of the central washers of all bearing numbers marked X is smaller than the outside diameter D of the housing washers.

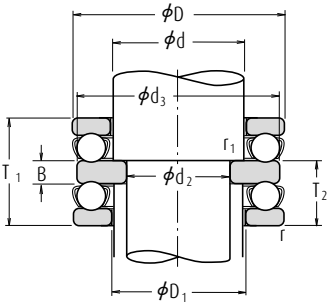


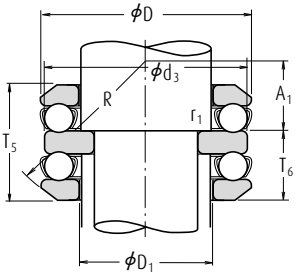




| With Aligning Seat Washer | Dimensions (mm) | | | | | | | | | | | Abutment and Fillet Dimensions (mm) | | | Mass (kg) approx. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $d_3$ | $D_1$ | $D_2$ | $D_3$ | $T_2$ | $T_6$ | $T_8$ | B | b | $A_1$ | R | $D_a$ max. | $r_a$ max. | $r_b$ max. | With Flat Seat | With Aligning Seat | With Aligning Seat Washer |
| **54215 U** | 110 | 77 | 92 | 115 | 28.5 | 29.8 | 33.5 | 10 | 9.5 | 47.5 | 90 | 92 | 1 | 1 | 1.54 | 1.66 | 2.06 |
| **54315 U** | 135 | 77 | 105 | 140 | 48.5 | 52.6 | 56.5 | 18 | 15 | 32.5 | 100 | 105 | 1.5 | 1 | 4.74 | 5.14 | 6.38 |
| **54415 U** | 160 | 78 | 115 | 165 | 70.5 | 74.5 | 80.5 | 26 | 21 | 36.5 | 125 | 115 | 2 | 1 | 10.8 | 11 | 13.7 |
| **54216 U** | 115 | 82 | 98 | 120 | 29 | 30.5 | 34 | 10 | 10 | 45 | 90 | 98 | 1 | 1 | 1.66 | 1.78 | 2.21 |
| **54316 U** | 140 | 82 | 110 | 145 | 48.5 | 52.1 | 56.5 | 18 | 15 | 45.5 | 112 | 110 | 1.5 | 1 | 4.99 | 5.39 | 6.61 |
| **54416 U** | 170 | 83 | 125 | 175 | 73.5 | 77.7 | 83.5 | 27 | 22 | 30.5 | 125 | 125 | 2 | 1 | 12.6 | 12.8 | 16 |
| **54417 XU** | 179.5 | 88 | 130 | 185 | 78.5 | 83.5 | 89.5 | 29 | 23 | 40.5 | 140 | 130 | 2 | 1 | 15.4 | 15.8 | 19.5 |
| **54217 U** | 125 | 88 | 105 | 130 | 33.5 | 35.6 | 39.5 | 12 | 11 | 49.5 | 100 | 105 | 1 | 1 | 2.26 | 2.45 | 3.02 |
| **54317 U** | 150 | 88 | 115 | 155 | 53 | 57.1 | 62 | 19 | 17.5 | 39 | 112 | 115 | 1.5 | 1 | 6.38 | 6.8 | 10.5 |
| **54418 XU** | 189.5 | 93 | 140 | 195 | 82.5 | 86.7 | 93.5 | 30 | 25.5 | 34.5 | 140 | 140 | 2 | 1 | 17.5 | 18.1 | 22.5 |
| **54218 U** | 135 | 93 | 110 | 140 | 38 | 41.5 | 45 | 14 | 13.5 | 42 | 100 | 110 | 1 | 1 | 3.09 | 3.42 | 4.39 |
| **54318 U** | 155 | 93 | 120 | 160 | 53.5 | 58.1 | 62.5 | 19 | 18 | 36.5 | 112 | 120 | 1.5 | 1 | 6.79 | 7.33 | 9.29 |
| **54420 XU** | 209.5 | 103 | 155 | 220 | 91.5 | 96.5 | 104.5 | 33 | 27 | 43.5 | 160 | 155 | 2.5 | 1 | 26.8 | 27.2 | 33.4 |
| **54220 U** | 150 | 103 | 125 | 155 | 41 | 43.9 | 48 | 15 | 14 | 49 | 112 | 125 | 1 | 1 | 4.08 | 4.54 | 5.64 |
| **54320 U** | 170 | 103 | 135 | 175 | 59 | 63.2 | 68 | 21 | 18 | 42 | 125 | 135 | 1.5 | 1 | 8.82 | 9.47 | 11.6 |
| – | 229 | 113 | – | – | 101.5 | – | – | 37 | – | – | – | 159 | 2.5 | 1 | 35.6 | – | – |
| **54222 U** | 160 | 113 | 135 | 165 | 41 | 43.2 | 48 | 15 | 14 | 62 | 125 | 135 | 1 | 1 | 4.39 | 4.83 | 5.94 |
| **54322 XU** | 189.5 | 113 | 150 | 195 | 67 | 71.2 | 76 | 24 | 20.5 | 47 | 140 | 150 | 2 | 1 | 12.7 | 13.5 | 16.6 |
| – | 249 | 123 | – | – | 108.5 | – | – | 40 | – | – | – | 174 | 3 | 1.5 | 47.6 | – | – |
| **54224 U** | 170 | 123 | 145 | 175 | 41.5 | 43.3 | 48.5 | 15 | 15 | 58.5 | 125 | 145 | 1 | 1 | 4.92 | 5.4 | 6.68 |
| **54324 XU** | 209.5 | 123 | 165 | 220 | 75 | 79.1 | 85 | 27 | 22 | 58 | 160 | 165 | 2 | 1 | 17.6 | 16.4 | 22.9 |
| – | 269 | 134 | – | – | 117 | – | – | 42 | – | – | – | 188 | 3 | 1.5 | 57.8 | – | – |
| **54226 XU** | 189.5 | 133 | 160 | 195 | 49 | 51.9 | 57 | 18 | 17 | 63 | 140 | 160 | 1.5 | 1 | 7.43 | 8.24 | 10.2 |
| – | 224 | 134 | – | – | 80 | – | – | 30 | – | – | – | 169 | 2 | 1 | 21.5 | – | – |
| – | 279 | 144 | – | – | 120 | – | – | 44 | – | – | – | 198 | 3 | 1.5 | 62.4 | – | – |
| **54228 XU** | 199.5 | 143 | 170 | 210 | 49.5 | 52.1 | 58.5 | 18 | 17 | 83.5 | 160 | 170 | 1.5 | 1 | 8.01 | 8.87 | 11.2 |
| – | 239 | 144 | – | – | 85.5 | – | – | 31 | – | – | – | 181 | 2 | 1 | 24.8 | – | – |
| – | 299 | 153 | – | – | 127.5 | – | – | 46 | – | – | – | 212 | 3 | 2 | 77.8 | – | – |
| **54230 XU** | 214.5 | 153 | 180 | 225 | 54.5 | 57.8 | 64.5 | 20 | 20.5 | 74.5 | 160 | 180 | 1.5 | 1 | 10.4 | 11.5 | 15 |
| – | 249 | 154 | – | – | 85.5 | – | – | 31 | – | – | – | 191 | 2 | 1 | 30.3 | – | – |
| – | 319 | 164 | – | – | 138 | – | – | 50 | – | – | – | 226 | 4 | 2 | 93.6 | – | – |

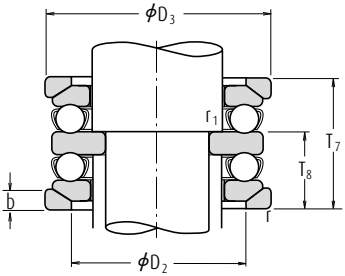
## Bore Diameter 135 – 190 mm




With Flat Seat



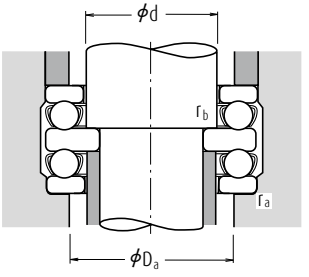

With Aligning Seat

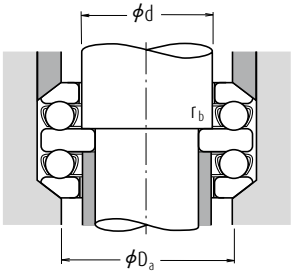


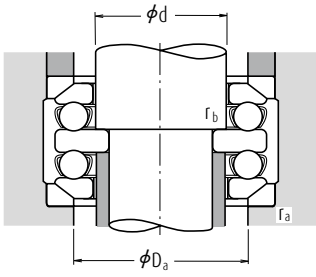

With Aligning Seat Washer

| Boundary Dimensions (mm) | | | | | | | | Basic Load Ratings (N) | | Limiting Speeds (min$^{-1}$) | | Bearing Numbers [1] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $d_2$ | d | D | $T_1$ | $T_5$ | $T_7$ | r min. | $r_1$ min. | $C_a$ | $C_{0a}$ | Grease | Oil | With Flat Seat | With Aligning Seat |
| **135** | 170 | 340 | 236 | – | – | 5 | 2.1 | 715 000 | 2 480 000 | 400 | 600 | **52434 X** | – |
| **140** | 160 | 225 | 90 | 97.4 | 110 | 1.5 | 1.1 | 249 000 | 805 000 | 850 | 1 300 | **52232 X** | **54232 X** |
| | 160 | 270 | 153 | – | – | 3 | 1.1 | 475 000 | 1 570 000 | 600 | 900 | **52332 X** | – |
| | 180 | 360 | 245 | – | – | 5 | 3 | 750 000 | 2 730 000 | 380 | 560 | **52436 X** | – |
| **150** | 170 | 240 | 97 | 104.4 | 117 | 1.5 | 1.1 | 280 000 | 915 000 | 800 | 1 200 | **52234 X** | **54234 X** |
| | 170 | 280 | 153 | – | – | 3 | 1.1 | 465 000 | 1 570 000 | 560 | 850 | **52334 X** | – |
| | 180 | 250 | 98 | 102.4 | 118 | 1.5 | 2 | 284 000 | 955 000 | 800 | 1 200 | **52236 X** | **54236 X** |
| | 180 | 300 | 165 | – | – | 3 | 3 | 480 000 | 1 680 000 | 530 | 800 | **52336 X** | – |
| **160** | 190 | 270 | 109 | 116.4 | 131 | 2 | 2 | 320 000 | 1 110 000 | 710 | 1 100 | **52238 X** | **54238 X** |
| | 190 | 320 | 183 | – | – | 4 | 2 | 550 000 | 1 960 000 | 480 | 710 | **52338 X** | – |
| **170** | 200 | 280 | 109 | 115.6 | 133 | 2 | 2 | 315 000 | 1 110 000 | 710 | 1 000 | **52240 X** | **54240 X** |
| | 200 | 340 | 192 | – | – | 4 | 2 | 600 000 | 2 220 000 | 450 | 670 | **52340 X** | – |
| **190** | 220 | 300 | 110 | 115.2 | 134 | 2 | 2 | 325 000 | 1 210 000 | 670 | 1 000 | **52244 X** | **54244 X** |

**Note** [1] The outside diameter $d_3$ of the central washers of all bearing numbers marked X is smaller than the outside diameter D of the housing washers.




| With Aligning Seat Washer | Dimensions (mm) | | | | | | | | | | | Abutment and Fillet Dimensions (mm) | | | Mass (kg) approx. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $d_3$ | $D_1$ | $D_2$ | $D_3$ | $T_2$ | $T_6$ | $T_8$ | B | b | $A_1$ | R | $D_a$ max. | $r_a$ max. | $r_b$ max. | With Flat Seat | With Aligning Seat | With Aligning Seat Washer |
| — | 339 | 174 | — | — | 143 | — | — | 50 | — | — | — | 240 | 4 | 2 | 110 | — | — |
| **54232 XU** | 224.5 | 163 | 190 | 235 | 55 | 58.7 | 65 | 20 | 21 | 70 | 160 | 190 | 1.5 | 1 | 11.2 | 12.7 | 16.5 |
| — | 269 | 164 | — | — | 93 | — | — | 33 | — | — | — | 205 | 2.5 | 1 | 35.1 | — | — |
| — | 359 | 184 | — | — | 148.5 | — | — | 52 | — | — | — | 254 | 4 | 2.5 | 126 | — | — |
| **54234 XU** | 239.5 | 173 | 200 | 250 | 59 | 62.7 | 69 | 21 | 21.5 | 87 | 180 | 200 | 1.5 | 1 | 13.6 | 15.2 | 19.8 |
| — | 279 | 174 | — | — | 93 | — | — | 33 | — | — | — | 215 | 2.5 | 1 | 40.8 | — | — |
| **54236 XU** | 249 | 183 | 210 | 260 | 59.5 | 61.7 | 69.5 | 21 | 21.5 | 108.5 | 200 | 210 | 1.5 | 2 | 14.8 | 16.1 | 20.6 |
| — | 299 | 184 | — | — | 101 | — | — | 37 | — | — | — | 229 | 2.5 | 2.5 | 46.3 | — | — |
| **54238 XU** | 269 | 194 | 230 | 280 | 66.5 | 70.2 | 77.5 | 24 | 23 | 93.5 | 200 | 230 | 2 | 2 | 22.1 | 22.2 | 29.8 |
| — | 319 | 195 | — | — | 111.5 | — | — | 40 | — | — | — | 244 | 3 | 2 | 113 | — | — |
| **54240 XU** | 279 | 204 | 240 | 290 | 66.5 | 69.8 | 78.5 | 24 | 23 | 120.5 | 225 | 240 | 2 | 2 | 23.1 | 23.2 | 30.6 |
| — | 339 | 205 | — | — | 117 | — | — | 42 | — | — | — | 258 | 3 | 2 | 78.4 | — | — |
| **54244 XU** | 299 | 224 | 260 | 310 | 67 | 69.6 | 79 | 24 | 25 | 114 | 225 | 260 | 2 | 2 | 25.2 | 27.8 | 34.1 |



## 9. THRUST CYLINDRICAL ROLLER BEARINGS


Page

Introduction.....B 332


### BEARINGS TABLE

### THRUST CYLINDRICAL ROLLER BEARINGS


Bore Dia. Page

35 – 320 mm.....B 334

# Thrust Cylindrical Roller Bearings

## DESIGN, TYPES, AND FEATURES

THRUST CYLINDRICAL ROLLER BEARINGS

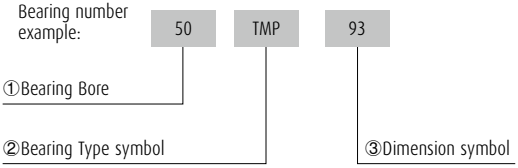
These are thrust bearings containing cylindrical rollers. They can sustain only axial loads, but they are suitable for heavy loads and have high axial rigidity. The cages are machined brass.

## TOLERANCES AND RUNNING ACCURACY

Thrust Cylindrical Roller Bearings ..... According to Table 7.6 (Pages A140 to A142)

## RECOMMENDED FITS

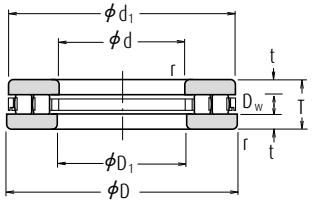
Thrust Cylindrical Roller Bearings ..... Table 8.4 (Page A164)
Table 8.6 (Page A165)



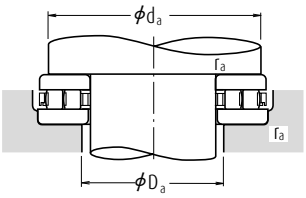
## MINIMUM AXIAL LOAD

It is necessary to apply some axial load to thrust bearings to prevent slippage between the rolling elements and raceways. For more details, please conctact NSK.

## Bore Diameter 35 – 130 mm



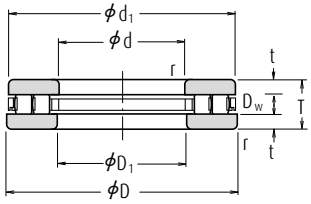

| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Limiting Speeds (min⁻¹) | |
|---|---|---|---|---|---|---|---|
| d | D | T | r min. | $C_a$ | $C_{0a}$ | Grease | Oil |
| **35** | 80 | 32 | 1.1 | 95 500 | 247 000 | 1 000 | 3 000 |
| **40** | 78 | 22 | 1 | 63 000 | 194 000 | 1 200 | 3 600 |
| **45** | 65 | 14 | 0.6 | 33 000 | 100 000 | 1 700 | 5 000 |
| | 85 | 24 | 1 | 71 000 | 233 000 | 1 100 | 3 400 |
| **50** | 110 | 27 | 1.1 | 139 000 | 470 000 | 900 | 2 800 |
| | 95 | 27 | 1.1 | 113 000 | 350 000 | 1 000 | 3 000 |
| **55** | 105 | 30 | 1.1 | 134 000 | 450 000 | 900 | 2 600 |
| **60** | 95 | 26 | 1 | 99 000 | 325 000 | 1 000 | 3 000 |
| | 110 | 30 | 1.1 | 139 000 | 480 000 | 850 | 2 600 |
| **65** | 100 | 27 | 1 | 110 000 | 325 000 | 950 | 2 800 |
| | 115 | 30 | 1.1 | 145 000 | 515 000 | 850 | 2 600 |
| **70** | 150 | 36 | 2 | 259 000 | 935 000 | 670 | 2 000 |
| | 125 | 34 | 1.1 | 191 000 | 635 000 | 750 | 2 200 |
| **75** | 100 | 19 | 1 | 63 500 | 221 000 | 1 100 | 3 400 |
| | 135 | 36 | 1.5 | 209 000 | 735 000 | 710 | 2 200 |
| **80** | 115 | 28 | 1 | 120 000 | 420 000 | 900 | 2 600 |
| | 140 | 36 | 1.5 | 208 000 | 740 000 | 710 | 2 000 |
| **85** | 110 | 19 | 1 | 75 000 | 298 000 | 1 100 | 3 200 |
| | 125 | 31 | 1 | 151 000 | 485 000 | 800 | 2 400 |
| | 150 | 39 | 1.5 | 257 000 | 995 000 | 630 | 1 900 |
| **90** | 120 | 22 | 1 | 96 000 | 370 000 | 950 | 3 000 |
| | 155 | 39 | 1.5 | 250 000 | 885 000 | 630 | 1 900 |
| **100** | 170 | 42 | 1.5 | 292 000 | 1 110 000 | 560 | 1 700 |
| **110** | 160 | 38 | 1.1 | 228 000 | 855 000 | 630 | 1 900 |
| | 190 | 48 | 2 | 390 000 | 1 490 000 | 500 | 1 500 |
| **120** | 170 | 39 | 1.1 | 233 000 | 895 000 | 600 | 1 800 |
| | 210 | 54 | 2.1 | 505 000 | 1 930 000 | 450 | 1 400 |
| **130** | 190 | 45 | 1.5 | 300 000 | 1 090 000 | 530 | 1 600 |
| | 225 | 58 | 2.1 | 585 000 | 2 370 000 | 430 | 1 300 |
| | 270 | 85 | 4 | 895 000 | 3 300 000 | 320 | 950 |



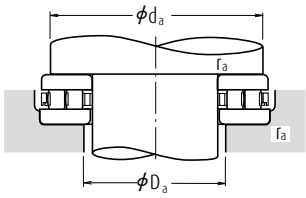

| Bearing Numbers | Dimensions (mm) | | | | Abutment and Fillet Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|
| | $d_1$ | $D_1$ | $D_w$ | t | $d_a$ min. | $D_a$ max. | $r_a$ max. | approx. |
| **35 TMP 14** | 80 | 37 | 12 | 10 | 71 | 46 | 1 | 0.97 |
| **40 TMP 93** | 78 | 42 | 8 | 7 | 71 | 48 | 1 | 0.525 |
| **45 TMP 11** | 65 | 47 | 6 | 4 | 60 | 49 | 0.6 | 0.144 |
| **45 TMP 93** | 85 | 47 | 8 | 8 | 78 | 53 | 1 | 0.665 |
| **50 TMP 74** | 109 | 52 | 11 | 8 | 100 | 61 | 1 | 1.52 |
| **50 TMP 93** | 93 | 52 | 11 | 8 | 89 | 57 | 1 | 0.94 |
| **55 TMP 93** | 105 | 55.2 | 11 | 9.5 | 98 | 63 | 1 | 1.28 |
| **60 TMP 12** | 95 | 62 | 10 | 8 | 88 | 67 | 1 | 0.735 |
| **60 TMP 93** | 110 | 62 | 11 | 9.5 | 103 | 68 | 1 | 1.36 |
| **65 TMP 12** | 100 | 67 | 12.5 | 7.25 | 93 | 71 | 1 | 0.805 |
| **65 TMP 93** | 115 | 65.2 | 11 | 9.5 | 108 | 73 | 1 | 1.44 |
| **70 TMP 74** | 149 | 72 | 15 | 10.5 | 137 | 84 | 2 | 3.8 |
| **70 TMP 93** | 125 | 72 | 14 | 10 | 117 | 78 | 1 | 1.95 |
| **75 TMP 11** | 100 | 77 | 8 | 5.5 | 96 | 79 | 1 | 0.41 |
| **75 TMP 93** | 135 | 77 | 14 | 11 | 125 | 84 | 1.5 | 2.42 |
| **80 TMP 12** | 115 | 82 | 11 | 8.5 | 109 | 86 | 1 | 1.02 |
| **80 TMP 93** | 138 | 82 | 14 | 11 | 130 | 91 | 1.5 | 2.54 |
| **85 TMP 11** | 110 | 87 | 7.5 | 5.75 | 105 | 89 | 1 | 0.46 |
| **85 TMP 12** | 125 | 88 | 14 | 8.5 | 118 | 92 | 1 | 1.36 |
| **85 TMP 93** | 148 | 87 | 14 | 12.5 | 140 | 95 | 1.5 | 3.2 |
| **90 TMP 11** | 119 | 91.5 | 9 | 6.5 | 114 | 95 | 1 | 0.725 |
| **90 TMP 93** | 155 | 90.2 | 16 | 11.5 | 144 | 101 | 1.5 | 3.3 |
| **100 TMP 93** | 170 | 103 | 16 | 13 | 159 | 110 | 1.5 | 4.25 |
| **110 TMP 12** | 160 | 113 | 15 | 11.5 | 150 | 119 | 1 | 2.66 |
| **110 TMP 93** | 190 | 113 | 19 | 14.5 | 179 | 120 | 2 | 6.15 |
| **120 TMP 12** | 170 | 123 | 15 | 12 | 160 | 129 | 1 | 2.93 |
| **120 TMP 93** | 210 | 123 | 22 | 16 | 199 | 129 | 2 | 8.55 |
| **130 TMP 12** | 187 | 133 | 19 | 13 | 177 | 142 | 1.5 | 4.5 |
| **130 TMP 93** | 225 | 133 | 22 | 18 | 214 | 140 | 2 | 10.4 |
| **130 TMP 94** | 270 | 133 | 32 | 26.5 | 254 | 150 | 3 | 26.2 |

**Remark** For cylindrical roller thrust bearings not listed above, please contact NSK.

## Bore Diameter 140 – 320 mm




| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Limiting Speeds (min⁻¹) | |
|---|---|---|---|---|---|---|---|
| d | D | T | r min. | $C_a$ | $C_{0a}$ | Grease | Oil |
| **140** | 200 | 46 | 2 | 285 000 | 1 120 000 | 500 | 1 500 |
| | 240 | 60 | 2.1 | 610 000 | 2 360 000 | 400 | 1 200 |
| | 280 | 85 | 4 | 990 000 | 3 800 000 | 300 | 900 |
| **150** | 215 | 50 | 2 | 375 000 | 1 500 000 | 480 | 1 400 |
| | 250 | 60 | 2.1 | 635 000 | 2 510 000 | 400 | 1 200 |
| **160** | 200 | 31 | 1 | 173 000 | 815 000 | 630 | 1 900 |
| | 270 | 67 | 3 | 745 000 | 3 150 000 | 360 | 1 100 |
| **170** | 240 | 55 | 1.5 | 485 000 | 1 960 000 | 430 | 1 300 |
| | 280 | 67 | 3 | 800 000 | 3 500 000 | 340 | 1 000 |
| **180** | 300 | 73 | 3 | 1 000 000 | 4 000 000 | 320 | 950 |
| | 360 | 109 | 5 | 1 640 000 | 6 200 000 | 240 | 710 |
| **190** | 270 | 62 | 3 | 705 000 | 2 630 000 | 360 | 1 100 |
| | 320 | 78 | 4 | 1 080 000 | 4 500 000 | 300 | 900 |
| **200** | 250 | 37 | 1.1 | 365 000 | 1 690 000 | 500 | 1 500 |
| | 340 | 85 | 4 | 1 180 000 | 5 150 000 | 280 | 800 |
| **220** | 270 | 37 | 1.1 | 385 000 | 1 860 000 | 480 | 1 500 |
| | 300 | 63 | 2 | 770 000 | 3 100 000 | 340 | 1 000 |
| **240** | 300 | 45 | 1.5 | 435 000 | 2 160 000 | 400 | 1 200 |
| | 340 | 78 | 2.1 | 965 000 | 4 100 000 | 280 | 850 |
| **260** | 320 | 45 | 1.5 | 460 000 | 2 350 000 | 400 | 1 200 |
| | 360 | 79 | 2.1 | 995 000 | 4 350 000 | 280 | 850 |
| **280** | 350 | 53 | 1.5 | 545 000 | 2 800 000 | 340 | 1 000 |
| | 380 | 80 | 2.1 | 1 050 000 | 4 750 000 | 260 | 800 |
| **300** | 380 | 62 | 2 | 795 000 | 4 000 000 | 300 | 900 |
| | 420 | 95 | 3 | 1 390 000 | 6 250 000 | 220 | 670 |
| **320** | 400 | 63 | 2 | 820 000 | 4 250 000 | 300 | 900 |
| | 440 | 95 | 3 | 1 420 000 | 6 550 000 | 220 | 670 |




| Bearing Numbers | Dimensions (mm) | | | | Abutment and Fillet Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|
| | $d_1$ | $D_1$ | $D_w$ | t | $d_a$ min. | $D_a$ max. | $r_a$ max. | approx. |
| **140 TMP 12** | 197 | 143 | 17 | 14.5 | 188 | 153 | 2 | 4.85 |
| **140 TMP 93** | 240 | 143 | 25 | 17.5 | 226 | 154 | 2 | 12.2 |
| **140 TMP 94** | 280 | 143 | 32 | 26.5 | 262 | 158 | 3 | 27.5 |
| **150 TMP 12** | 215 | 153 | 19 | 15.5 | 202 | 163 | 2 | 6.15 |
| **150 TMP 93** | 250 | 153 | 25 | 17.5 | 236 | 165 | 2 | 12.8 |
| **160 TMP 11** | 200 | 162 | 11 | 10 | 191 | 168 | 1 | 2.21 |
| **160 TMP 93** | 265 | 164 | 25 | 21 | 255 | 173 | 2.5 | 16.9 |
| **170 TMP 12** | 237 | 173 | 22 | 16.5 | 227 | 182 | 1.5 | 8.2 |
| **170 TMP 93** | 280 | 173 | 25 | 21 | 265 | 183 | 2.5 | 17.7 |
| **180 TMP 93** | 300 | 185 | 32 | 20.5 | 284 | 194 | 2.5 | 22.5 |
| **180 TMP 94** | 354 | 189 | 45 | 32 | 335 | 205 | 4 | 58.2 |
| **190 TMP 12** | 266 | 195 | 30 | 16 | 255 | 200 | 2.5 | 11.8 |
| **190 TMP 93** | 320 | 195 | 32 | 23 | 303 | 205 | 3 | 27.6 |
| **200 TMP 11** | 247 | 203 | 17 | 10 | 242 | 207 | 1 | 4.1 |
| **200 TMP 93** | 340 | 205 | 32 | 26.5 | 322 | 218 | 3 | 34.5 |
| **220 TMP 11** | 267 | 223 | 17 | 10 | 262 | 227 | 1 | 4.5 |
| **220 TMP 12** | 297 | 224 | 30 | 16.5 | 287 | 232 | 2 | 13.5 |
| **240 TMP 11** | 297 | 243 | 18 | 13.5 | 288 | 251 | 1.5 | 7.2 |
| **240 TMP 12** | 335 | 244 | 32 | 23 | 322 | 258 | 2 | 23.3 |
| **260 TMP 11** | 317 | 263 | 18 | 13.5 | 308 | 272 | 1.5 | 7.75 |
| **260 TMP 12** | 355 | 264 | 32 | 23.5 | 342 | 276 | 2 | 25.2 |
| **280 TMP 11** | 347 | 283 | 20 | 16.5 | 335 | 294 | 1.5 | 11.6 |
| **280 TMP 12** | 375 | 284 | 32 | 24 | 362 | 296 | 2 | 27.2 |
| **300 TMP 11** | 376 | 304 | 25 | 18.5 | 365 | 315 | 2 | 16.7 |
| **300 TMP 12** | 415 | 304 | 38 | 28.5 | 398 | 322 | 2.5 | 42 |
| **320 TMP 11** | 396 | 324 | 25 | 19 | 385 | 335 | 2 | 18 |
| **320 TMP 12** | 435 | 325 | 38 | 28.5 | 418 | 340 | 2.5 | 44.5 |

**Remark** For cylindrical roller thrust bearings not listed above, please contact NSK.


NSK

## 10. THRUST TAPERED ROLLER BEARINGS


Page

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## BEARINGS TABLE

## THRUST TAPERED ROLLER BEARINGS


Bore Dia. Page

101.600 – 600 mm .....B 342

## DESIGN, TYPES, AND FEATURES

THRUST TAPERED ROLLER BEARINGS

These are thrust bearings containing tapered rollers. TT-type bearings, which have a rib on the housing washer, can accurately guide the shaft in the radial direction. TTF-type bearings, which have no rib on the housing washer, can tolerate some eccentricity during operation.




Fig 1 TT, TTF Base Structure

## TOLERANCES AND RUNNING ACCURACY

Thrust Tapered Roller Bearings ..... Table 7.7 (Page A144)

## RECOMMENDED FITS

Thrust Tapered Roller Bearings ..... Table 8.4 (Pages A164)
Table 8.6 (Pages A165)

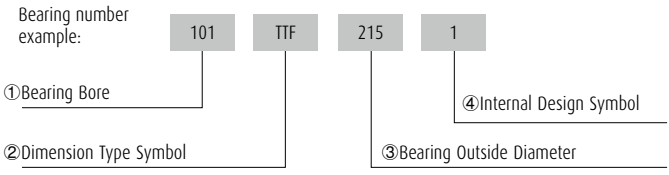
For inch design tapered roller thrust bearings, please contact NSK.

## MINIMUM AXIAL LOAD

It is necessary to apply some axial load to thrust bearings to prevent slippage between the rolling elements and raceways. For more details, please contact NSK.

## USAGE EXAMPLE

Typical structure of Heavy Duty Extruder is shown in Figure 2.



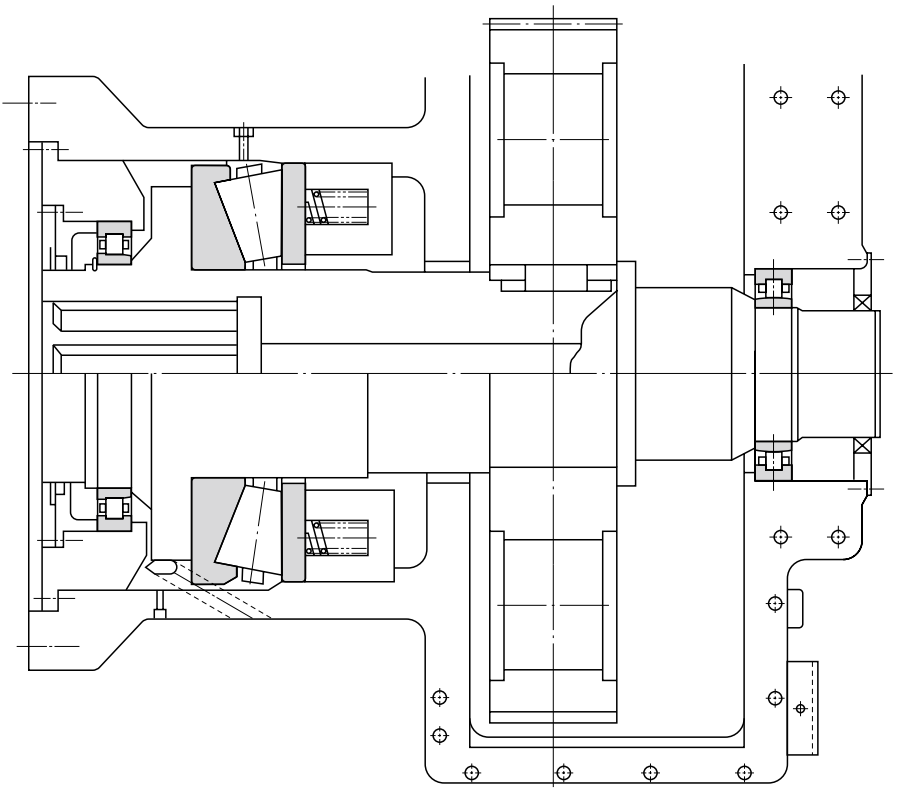
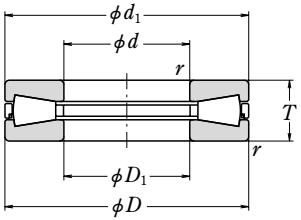
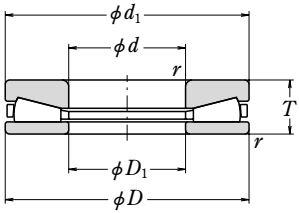


Figure 2 Thrust Tapered Roller Bearing in Heavy Duty Extruder

## TT, TTF Types
## Bore Diameter 101.600 – 168.275 mm




TT



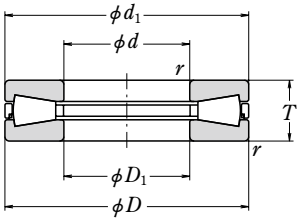

TTF

| Boundary Dimensions (mm/inch) | | | | Basic Load Ratings (kN) | | Bearing Numbers |
|---|---|---|---|---|---|---|
| d | D | T | r min. | $C_a$ | $C_{0a}$ | |
| **101.600** | 215.900 | 46.038 | 3.3 | 710 | 2 900 | *101TT2151 |
| 4.0000 | 8.5000 | 1.8125 | 3.3 | 710 | 2 900 | *101TT2151 |
| **111.760** | 223.520 | 55.880 | 3.3 | 790 | 2 920 | *111TT2251 |
| 4.4000 | 8.8000 | 2.2000 | 3.3 | 790 | 2 920 | *111TT2251 |
| **114.300** | 250.825 | 53.975 | 4.0 | 970 | 4 100 | *114TT2551 |
| 4.5000 | 9.8750 | 2.1250 | 4.0 | 970 | 4 100 | *114TT2551 |
| **127.000** | 266.700 | 58.738 | 4.8 | 1 040 | 4 350 | *127TT2551 |
| 5.0000 | 10.5000 | 2.3125 | 4.8 | 1 040 | 4 350 | *127TT2551 |
| | 266.700 | 58.738 | 4.8 | 1 030 | 4 500 | *127TTF2651 |
| | 10.5000 | 2.3125 | 4.8 | 1 030 | 4 500 | *127TTF2651 |
| **128.575** | 265.100 | 63.500 | 6.4 | 1 040 | 4 350 | *128TT2651 |
| 5.0620 | 10.4370 | 2.5000 | 6.4 | 1 040 | 4 350 | *128TT2651 |
| **130** | 250 | 70 | 2.1 | 1 100 | 4 100 | 130TTF2501 |
| **135** | 245 | 65 | 2.1 | 855 | 3 100 | 135TT2401 |
| **150** | 300 | 90 | 5 | 1 470 | 6 300 | 150TTF3001 |
| **152.400** | 317.500 | 69.850 | 6.4 | 1 470 | 6 330 | *152TTF3151 |
| 6.0000 | 12.5000 | 2.7500 | 6.4 | 1 470 | 6 300 | *152TTF3151 |
| | 317.500 | 69.850 | 6.4 | 1 550 | 6 700 | *152TT3152 |
| | 12.2500 | 2.7500 | 6.4 | 1 550 | 6 700 | *152TT3152 |
| **165.100** | 311.150 | 88.900 | 6.4 | 1 560 | 5 250 | *165TT3151 |
| 6.5000 | 12.2500 | 3.5000 | 6.4 | 1 560 | 5 250 | *165TT3151 |
| **168.275** | 304.800 | 69.850 | 6.4 | 1 230 | 5 000 | *168TTF3051 |
| 6.6250 | 12.0000 | 2.7500 | 6.4 | 1 230 | 5 000 | *168TTF3051 |

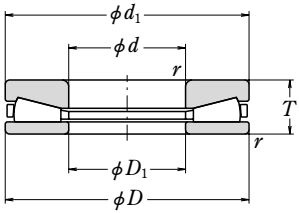
| Dimensions (mm) | | Corner Radius of Shaft or Housing | Mass (kg) |
|---|---|---|---|
| $D_1$ | $d_1$ | $r_a$ | approx. |
| 103.200 | 214.300 | 3.3 | 8.9 |
| 103.200 | 214.300 | 3.3 | 8.9 |
| 113.300 | 221.900 | 3.3 | 11.2 |
| 113.300 | 221.900 | 3.3 | 11.2 |
| 114.500 | 250.825 | 4.0 | 14.4 |
| 114.500 | 250.825 | 4.0 | 14.4 |
| 128.600 | 265.100 | 4.8 | 17.3 |
| 128.600 | 265.100 | 4.8 | 17.3 |
| 128.600 | 265.100 | 4.8 | 17.3 |
| 128.600 | 265.100 | 4.8 | 17.3 |
| 128.900 | 265.100 | 6.4 | 18.2 |
| 128.900 | 265.100 | 6.4 | 18.2 |
| 130.3 | 250 | 2 | 17 |
| 135.3 | 245 | 2 | 14.5 |
| 152 | 306 | 4 | 34.2 |
| 152.700 | 315.900 | 6.4 | 28.9 |
| 152.700 | 315.900 | 6.4 | 28.9 |
| 152.400 | 317.500 | 6.4 | 28.9 |
| 152.400 | 317.500 | 6.4 | 28.9 |
| 165.400 | 311.150 | 6.4 | 33 |
| 165.400 | 311.150 | 6.4 | 33 |
| 169.000 | 302.500 | 6.4 | 24.1 |
| 169.000 | 302.500 | 6.4 | 24.1 |

**Note** * Bearings marked * are inch design.

## TT, TTF Types
## Bore Diameter 170 – 241.300 mm




TT



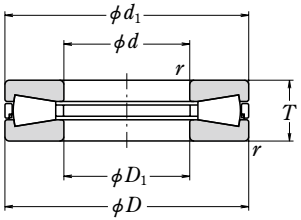

TTF

| Boundary Dimensions (mm/inch) | | | | Basic Load Ratings (kN) | | Bearing Numbers |
|---|---|---|---|---|---|---|
| d | D | T | r min. | $C_a$ | $C_{0a}$ | |
| **170** | 320 | 100 | 5 | 1 650 | 5 550 | **170TT3201** |
| **174.625** | 358.775 | 82.550 | 6.4 | 1 740 | 7 400 | *174TT3551 |
| 6.8750 | 14.1250 | 3.2500 | 6.4 | 1 740 | 7 400 | *174TT3551 |
| | 358.775 | 82.550 | 6.4 | 1 740 | 7 400 | *174TTF3551 |
| | 14.1250 | 3.2500 | 6.4 | 1 740 | 7 400 | *174TTF3551 |
| **177.800** | 368.300 | 82.550 | 8.0 | 1 900 | 8 250 | *177TT3651 |
| 7.0000 | 14.5000 | 3.2500 | 8.0 | 1 900 | 8 250 | *177TT3651 |
| **203.200** | 419.100 | 92.075 | 9.7 | 2 530 | 11 300 | *203TT4151 |
| 8.0000 | 16.5000 | 3.6250 | 9.7 | 2 530 | 11 300 | *203TT4151 |
| | 419.100 | 92.075 | 9.7 | 2 530 | 11 300 | *203TTF4153A |
| | 16.5000 | 3.6250 | 9.7 | 2 530 | 11 300 | *203TTF4153A |
| | 419.100 | 120.650 | 9.7 | 2 530 | 11 300 | *203TT4152 |
| | 16.5000 | 4.7500 | 9.7 | 2 530 | 11 300 | *203TT4152 |
| | 419.100 | 120.650 | 9.7 | 2 530 | 11 300 | *203TTF4152 |
| | 16.5000 | 4.7500 | 9.7 | 2 530 | 11 300 | *203TTF4152 |
| **206.375** | 419.100 | 120.370 | C10 | 2 590 | 11 700 | *206TT4151 |
| 8.1250 | 16.5000 | 4.7390 | C10 | 2 590 | 11 700 | *206TT4151 |
| **228.600** | 482.600 | 104.775 | 11.2 | 3 350 | 16 400 | *228TT4851 |
| 9.0000 | 19.0000 | 4.1250 | 11.2 | 3 350 | 16 400 | *228TT4851 |
| | 482.600 | 104.775 | 11.2 | 3 350 | 16 400 | *228TTF4851 |
| | 19.0000 | 4.1250 | 11.2 | 3 350 | 16 400 | *228TTF4851 |
| **234.950** | 546.100 | 127.000 | 15.9 | 4 600 | 21 400 | *234TT5451 |
| 9.2500 | 21.5000 | 5.0000 | 15.9 | 4 600 | 21 400 | *234TT5451 |
| **241** | 404 | 110 | 4 | 2 200 | 8 650 | **241TTF4002** |
| **241.300** | 496.888 | 129.000 | C8 | 3 450 | 16 700 | *241TT4952 |
| 9.5000 | 19.5625 | 5.0787 | C8 | 3 450 | 16 700 | *241TT4952 |

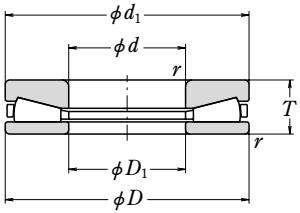
| Dimensions (mm) | | Corner Radius of Shaft or Housing | Mass (kg) |
|---|---|---|---|
| $D_1$ | $d_1$ | $r_a$ | approx. |
| 170.5 | 320 | 4 | 39.3 |
| 174.625 | 358.775 | 6.4 | 43.3 |
| 174.625 | 358.775 | 6.4 | 43.3 |
| 174.625 | 358.775 | 6.4 | 43.3 |
| 174.625 | 358.775 | 6.4 | 43.3 |
| 180.400 | 365.800 | 8.0 | 45.9 |
| 180.400 | 365.800 | 8.0 | 45.9 |
| 205.600 | 416.700 | 9.7 | 66.1 |
| 205.600 | 416.700 | 9.7 | 66.1 |
| 203.200 | 419.100 | 9.7 | 66.1 |
| 203.200 | 419.100 | 9.7 | 66.1 |
| 205.600 | 416.700 | 9.7 | 86.6 |
| 205.600 | 416.700 | 9.7 | 86.6 |
| 205.600 | 416.700 | 9.7 | 86.6 |
| 205.600 | 416.700 | 9.7 | 86.6 |
| 206.375 | 419.100 | 6 | 85.5 |
| 206.375 | 419.100 | 6 | 85.5 |
| 228.900 | 482.600 | 11.2 | 101 |
| 228.900 | 482.600 | 11.2 | 101 |
| 230.600 | 480.600 | 11.2 | 101 |
| 230.600 | 480.600 | 11.2 | 101 |
| 237.000 | 544.000 | 15.9 | 165 |
| 237.000 | 544.000 | 15.9 | 165 |
| 241 | 404 | 3 | 61.8 |
| 241.300 | 496.888 | 5 | 130 |
| 241.300 | 496.888 | 5 | 130 |

**Note** * Bearings marked * are inch design.

## TT, TTF Types
## Bore Diameter 254.000 – 600 mm

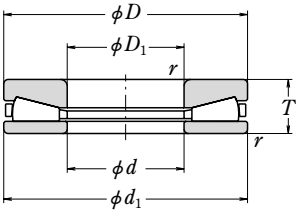



TT




TTF

| Boundary Dimensions (mm/inch) | | | | Basic Load Ratings (kN) | | Bearing Numbers |
|---|---|---|---|---|---|---|
| d | D | T | r min. | $C_a$ | $C_{0a}$ | |
| **254.000** | 539.750 | 117.475 | 11.2 | 3 950 | 18 600 | *254TTF5351 |
| 10.0000 | 21.2500 | 4.6250 | 11.2 | 3 950 | 18 600 | *254TTF5351 |
| **260** | 360 | 75 | 2.1 | 1 110 | 1 110 | 260TTF3601 |
| **273.050** | 552.450 | 133.350 | C8 | 4 400 | 20 700 | *273TT5551 |
| 10.7500 | 21.7500 | 5.2500 | C8 | 4 400 | 20 700 | *273TT5551 |
| **279.400** | 603.250 | 136.525 | 11.2 | 5 400 | 25 200 | *279TT6051 |
| 11.0000 | 23.7500 | 5.3750 | 11.2 | 5 400 | 25 200 | *279TT6051 |
| **330** | 440 | 85 | 3 | 1 300 | 6 300 | 330TTF4401 |
| **340** | 460 | 96 | 3 | 1 690 | 7 750 | 340TTF4603 |
| **350** | 460 | 85 | 2 | 1 370 | 6 600 | 350TTF4602A(1) |
| **360** | 470 | 85 | 4 | 1 440 | 6 950 | 360TTF4701 |
| **360** | 600 | 120 | 4 | 3 700 | 20 100 | 360TTF6201 |
| **380** | 550 | 110 | 4 | 2 760 | 12 100 | 380TTF5501 |
| **406.400** | 711.200 | 146.050 | 9.7 | 5 900 | 28 600 | *406TT7151 |
| 16.0000 | 28.0000 | 5.7500 | 9.7 | 5 900 | 28 600 | *406TT7151 |
| | 838.200 | 177.800 | 12.7 | 8 950 | 46 500 | *406TT8351 |
| | 33.0000 | 7.0000 | 12.7 | 8 950 | 46 500 | *406TT8351 |
| **431.800** | 863.600 | 228.600 | 10.4 | 15 100 | 69 500 | *431TTF8651 |
| 17.0000 | 34.0000 | 9.0000 | 10.4 | 15 100 | 69 500 | *431TTF8651 |
| **440** | 600 | 105 | 4 | 2 720 | 13 900 | 440TTF6001 |
| **450** | 570 | 100 | 3 | 2 170 | 10 500 | 450TTF5701 |
| **460** | 580 | 90 | 3 | 1 890 | 9 550 | 460TTF5801 |
| **500** | 630 | 82 | 3 | 2 020 | 11 600 | 500TTF6301 |
| **508** | 730.25 | 120.65 | 6 | 4 900 | 26 100 | 508TT7301 |
| **508.000** | 990.600 | 196.850 | 12.7 | 12 000 | 65 000 | *508TT9951 |
| 20.0000 | 39.0000 | 7.7500 | 12.7 | 12 000 | 65 000 | *508TT9951 |
| **558** | 780 | 120 | 9.5 | 4 800 | 25 500 | 558TT7801 |
| **558.800** | 1 066.800 | 285.750 | 10.4 | 21 100 | 94 500 | *558TTF1051 |
| 22.0000 | 42.0000 | 11.2500 | 10.4 | 21 100 | 94 500 | *558TTF1051 |
| **560** | 670 | 85 | 3 | 1 950 | 10 700 | 560TTF6701 |
| **600** | 710 | 86 | 3 | 1 900 | 10 700 | 600TTF7101 |

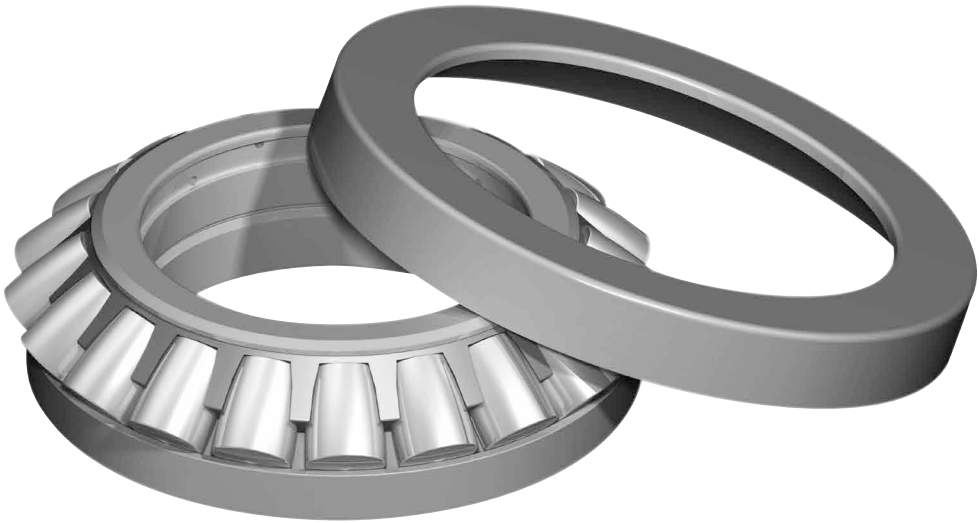



TTF-1

| Dimensions (mm) | | Corner Radius of Shaft or Housing | Mass (kg) |
|---|---|---|---|
| $D_1$ | $d_1$ | $r_a$ | approx. |
| 254.000 | 539.750 | 11.2 | 142 |
| 254.000 | 539.750 | 11.2 | 142 |
| 260.3 | 360 | 2 | 24.8 |
| 273.050 | 552.450 | 5 | 164 |
| 273.050 | 552.450 | 5 | 164 |
| 279.700 | 603.250 | 11.2 | 208 |
| 279.700 | 603.250 | 11.2 | 208 |
| 331 | 440 | 2.5 | 38.5 |
| 340 | 460 | 2.5 | 49.2 |
| 351 | 450 | 2 | 40.4 |
| 360.4 | 470 | 3 | 41.4 |
| 366 | 620 | 3 | 148 |
| 381 | 550 | 3 | 92.9 |
| 406.800 | 711.200 | 9.7 | 266 |
| 406.800 | 711.200 | 9.7 | 266 |
| 406.800 | 837.800 | 12.7 | 510 |
| 406.800 | 837.800 | 12.7 | 510 |
| 435.000 | 862.000 | 10.4 | 683 |
| 435.000 | 862.000 | 10.4 | 683 |
| 440 | 600 | 3 | 93.3 |
| 455 | 569 | 2.5 | 65.4 |
| 465 | 579 | 2.5 | 60 |
| 505 | 628 | 2.5 | 64.3 |
| 509 | 730.25 | 5 | 177 |
| 508.000 | 990.600 | 12.7 | 760 |
| 508.000 | 990.600 | 12.7 | 760 |
| 558 | 780 | 8 | 190 |
| 561.980 | 1 065.219 | 10.4 | 1 260 |
| 561.980 | 1 065.219 | 10.4 | 1 260 |
| 565 | 668 | 2.5 | 61.4 |
| 604 | 710 | 2.5 | 66.2 |

**Note** * Bearings marked * are inch design.

(1) For this bearing, the dimensional symbols are defined by Figure TTF-1.



## 11. THRUST SPHERICAL ROLLER BEARINGS


Page

Introduction.....B 350


## BEARINGS TABLE

## THRUST TAPERED ROLLER BEARINGS


Bore Dia. Page

60 – 500 mm.....B 352

# Thrust Spherical Roller Bearings

## DESIGN, TYPES, AND FEATURES

THRUST SPHERICAL ROLLER BEARINGS

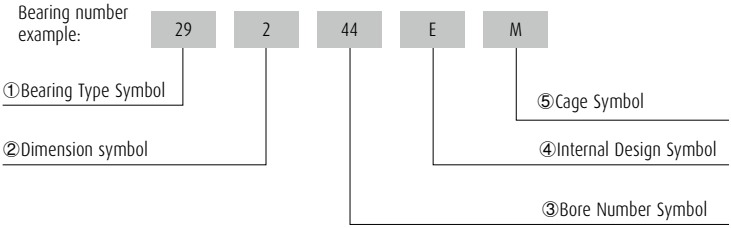
These are thrust bearings containing convex rollers. They have a selfaligning capability and are free of any influence of mounting error or shaft deflection. Besides the original type, the E type with pressed cages for high load capacity is also available. Their bearing numbers are suffixed by E. For horizontal shaft or high speed application, machined brass cages are recommended. For details, contact NSK. Since there are several places where lubrication is difficult, such as the area between the roller heads and inner ring rib, the sliding surfaces between cage and guide sleeve, etc., oil lubrication should be used even at low speed. The cages in the original type are machined brass.

## TOLERANCES AND RUNNING ACCURACY

Thrust Spherical Roller Bearings ..... Table 7.8 (Page A145)

## RECOMMENDED FITS

Thrust Spherical Roller Bearings ..... Table 8.4 (Page A164)
Table 8.6 (Page A165)



### Dimensions related to Mounting

The dimensions related to mounting of thrust spherical roller bearings are listed in the Bearing Table. If the bearing load is heavy, it is necessary to design the shaft shoulder with ample strength in order to provide sufficient support for the shaft washer.

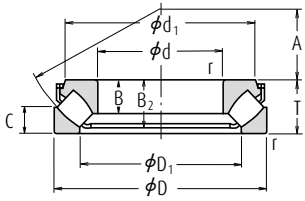
### Permissible Misalignment

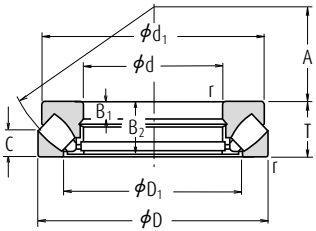
The permissible misalignment of thrust spherical roller bearings varies depending on the size, but it is approximately 0.018 to 0.036 radian (1° to 2°) with average loads.

### Minimum axial load

It is necessary to apply some axial load to thrust bearings to prevent slippage between the rolling elements and raceways. For more details, please refer to Page A198.

## Bore Diameter 60 – 200 mm




| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Limiting Speeds ($min^{-1}$) | Bearing Numbers |
|---|---|---|---|---|---|---|---|
| d | D | T | r min. | $C_a$ | $C_{0a}$ | Oil | |
| **60** | 130 | 42 | 1.5 | 330 000 | 885 000 | 2 600 | **29412 E** |
| **65** | 140 | 45 | 2 | 405 000 | 1 100 000 | 2 400 | **29413 E** |
| **70** | 150 | 48 | 2 | 450 000 | 1 240 000 | 2 400 | **29414 E** |
| **75** | 160 | 51 | 2 | 515 000 | 1 430 000 | 2 200 | **29415 E** |
| **80** | 170 | 54 | 2.1 | 575 000 | 1 600 000 | 2 000 | **29416 E** |
| **85** | 150 | 39 | 1.5 | 330 000 | 1 040 000 | 2 400 | **29317 E** |
| | 180 | 58 | 2.1 | 630 000 | 1 760 000 | 1 900 | **29417 E** |
| **90** | 155 | 39 | 1.5 | 350 000 | 1 080 000 | 2 200 | **29318 E** |
| | 190 | 60 | 2.1 | 695 000 | 1 950 000 | 1 800 | **29418 E** |
| **100** | 170 | 42 | 1.5 | 410 000 | 1 280 000 | 2 000 | **29320 E** |
| | 210 | 67 | 3 | 840 000 | 2 400 000 | 1 600 | **29420 E** |
| **110** | 190 | 48 | 2 | 530 000 | 1 710 000 | 1 800 | **29322 E** |
| | 230 | 73 | 3 | 1 010 000 | 2 930 000 | 1 500 | **29422 E** |
| **120** | 210 | 54 | 2.1 | 645 000 | 2 100 000 | 1 600 | **29324 E** |
| | 250 | 78 | 4 | 1 160 000 | 3 400 000 | 1 400 | **29424 E** |
| **130** | 225 | 58 | 2.1 | 740 000 | 2 450 000 | 1 500 | **29326 E** |
| | 270 | 85 | 4 | 1 330 000 | 3 900 000 | 1 200 | **29426 E** |
| **140** | 240 | 60 | 2.1 | 840 000 | 2 810 000 | 1 400 | **29328 E** |
| | 280 | 85 | 4 | 1 370 000 | 4 200 000 | 1 200 | **29428 E** |
| **150** | 250 | 60 | 2.1 | 870 000 | 2 900 000 | 1 400 | **29330 E** |
| | 300 | 90 | 4 | 1 580 000 | 4 900 000 | 1 100 | **29430 E** |
| **160** | 270 | 67 | 3 | 1 010 000 | 3 400 000 | 1 300 | **29332 E** |
| | 320 | 95 | 5 | 1 740 000 | 5 400 000 | 1 100 | **29432 E** |
| **170** | 280 | 67 | 3 | 1 050 000 | 3 500 000 | 1 200 | **29334 E** |
| | 340 | 103 | 5 | 1 680 000 | 5 800 000 | 1 000 | **29434** |
| **180** | 300 | 73 | 3 | 1 230 000 | 4 200 000 | 1 100 | **29336 E** |
| | 360 | 109 | 5 | 1 870 000 | 6 500 000 | 900 | **29436** |
| **190** | 320 | 78 | 4 | 1 370 000 | 4 700 000 | 1 100 | **29338 E** |
| | 380 | 115 | 5 | 2 100 000 | 7 450 000 | 850 | **29438** |
| **200** | 280 | 48 | 2 | 540 000 | 2 310 000 | 1 500 | **29240** |
| | 340 | 85 | 4 | 1 570 000 | 5 450 000 | 1 000 | **29340 E** |
| | 400 | 122 | 5 | 2 290 000 | 8 150 000 | 800 | **29440** |

**Note** (1) For heavy load applications, a $d_a$ value should be chosen which is large enough to support the shaft washer rib.

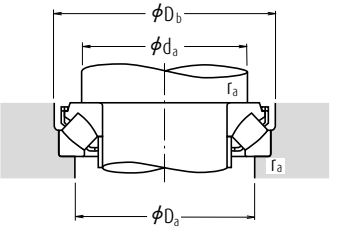
## Dynamic Equivalent Load

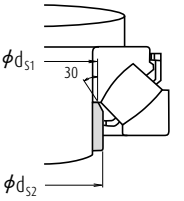
$P=1.2F_r+F_a$

## Static Equivalent Load

$P_0=2.8F_r+F_a$

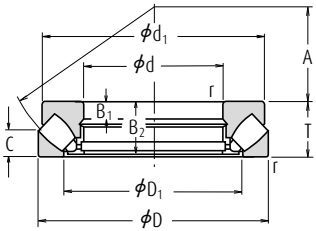
However, $F_r/F_a \leq 0.55$ must be satisfied.




| Dimensions (mm) | | | | | | Spacer Sleeve Dimensions (mm) | | Abutment and Fillet Dimensions (mm) | | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $d_1$ | $D_1$ | $B,B_1$ | $B_2$ | C | A | $d_{S1}$ max. | $d_{S2}$ max. | $d_a$(1) min. | $D_a$ max. | $D_b$ min. | $r_a$ max. | approx. |
| 114.5 | 89 | 27 | 38 | 20 | 38 | 67 | 67 | 90 | 108 | 133 | 1.5 | 2.55 |
| 121.5 | 93 | 29.5 | 40.5 | 22 | 42 | 72 | 72 | 100 | 115 | 143 | 2 | 3.2 |
| 131.5 | 102 | 31 | 43 | 24 | 44 | 78 | 78 | 105 | 125 | 153 | 2 | 3.9 |
| 138 | 107 | 33.5 | 46 | 25 | 47 | 83 | 83 | 115 | 132 | 163 | 2 | 4.65 |
| 148 | 114.5 | 35 | 48.5 | 27 | 50 | 89 | 89 | 120 | 140 | 173 | 2 | 5.55 |
| 134.5 | 112 | 24.5 | 35.5 | 19 | 50 | 91 | 91 | 115 | 135 | 153 | 1.5 | 2.7 |
| 156.5 | 124 | 37 | 51.5 | 28 | 54 | 95 | 95 | 130 | 150 | 183 | 2 | 6.55 |
| 139.5 | 118 | 24.5 | 35 | 19 | 52 | 97 | 97 | 120 | 140 | 158 | 1.5 | 2.83 |
| 165.5 | 129.5 | 39 | 54.5 | 29 | 56 | 100 | 100 | 135 | 157 | 193 | 2 | 7.55 |
| 152 | 128 | 26.2 | 38 | 20.8 | 58 | 107 | 107 | 130 | 150 | 173 | 1.5 | 3.6 |
| 185 | 144 | 43 | 59.5 | 33 | 62 | 111 | 111 | 150 | 175 | 214 | 2.5 | 10.3 |
| 169.5 | 142.5 | 30.3 | 43.5 | 24 | 64 | 117 | 117 | 145 | 165 | 193 | 2 | 5.25 |
| 200 | 157 | 47 | 64.5 | 36 | 69 | 121 | 129 | 165 | 190 | 234 | 2.5 | 13.3 |
| 187.5 | 156.5 | 34 | 48.5 | 27 | 70 | 130 | 130 | 160 | 180 | 214 | 2 | 7.3 |
| 215 | 171 | 50.5 | 69.5 | 38 | 74 | 132 | 142 | 180 | 205 | 254 | 3 | 16.6 |
| 203.5 | 168.5 | 37 | 53.5 | 28 | 76 | 141 | 143 | 170 | 195 | 229 | 2 | 8.95 |
| 235 | 185 | 54 | 74.5 | 42 | 81 | 143 | 153 | 195 | 225 | 275 | 3 | 21.1 |
| 216.5 | 179 | 38.5 | 54 | 30 | 82 | 148 | 154 | 185 | 205 | 244 | 2 | 10.4 |
| 244.5 | 195.5 | 54 | 74.5 | 42 | 86 | 153 | 162 | 205 | 235 | 285 | 3 | 22.2 |
| 224 | 190 | 38 | 54.5 | 29 | 87 | 158 | 163 | 195 | 215 | 254 | 2 | 10.8 |
| 266 | 209 | 58 | 81 | 44 | 92 | 164 | 175 | 220 | 250 | 306 | 3 | 27.3 |
| 243 | 203 | 42 | 60 | 33 | 92 | 169 | 176 | 210 | 235 | 275 | 2.5 | 14.3 |
| 278 | 224.5 | 60.5 | 84.5 | 46 | 99 | 175 | 189 | 230 | 265 | 326 | 4 | 32.1 |
| 252 | 214.5 | 42.2 | 60.5 | 32 | 96 | 178 | 188 | 220 | 245 | 285 | 2.5 | 14.8 |
| 310 | 243 | 37 | 99 | 50 | 104 | — | — | 245 | 285 | — | 4 | 43.5 |
| 270 | 227 | 46 | 65.5 | 36 | 103 | 189 | 195 | 235 | 260 | 306 | 2.5 | 19 |
| 330 | 255 | 39 | 105 | 52 | 110 | — | — | 260 | 300 | — | 4 | 52 |
| 288.5 | 244 | 49 | 69 | 38 | 110 | 200 | 211 | 250 | 275 | 326 | 3 | 23 |
| 345 | 271 | 41 | 111 | 55 | 117 | — | — | 275 | 320 | — | 4 | 60 |
| 266 | 236 | 15 | 46 | 24 | 108 | — | — | 235 | 255 | — | 2 | 8.55 |
| 306.5 | 257 | 53.5 | 75 | 41 | 116 | 211 | 224 | 265 | 295 | 346 | 3 | 28.5 |
| 365 | 280 | 43 | 117 | 59 | 122 | — | — | 290 | 335 | — | 4 | 69 |

## Bore Diameter 220 – 420 mm




| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Limiting Speeds (min⁻¹) | Bearing Numbers |
|---|---|---|---|---|---|---|---|
| d | D | T | r min. | $C_a$ | $C_{0a}$ | Oil | |
| **220** | 300 | 48 | 2 | 560 000 | 2 500 000 | 1 400 | **29244** |
| | 360 | 85 | 4 | 1 340 000 | 5 200 000 | 950 | **29344** |
| | 420 | 122 | 6 | 2 350 000 | 8 650 000 | 800 | **29444** |
| **240** | 340 | 60 | 2.1 | 800 000 | 3 450 000 | 1 200 | **29248** |
| | 380 | 85 | 4 | 1 360 000 | 5 400 000 | 950 | **29348** |
| | 440 | 122 | 6 | 2 420 000 | 9 100 000 | 750 | **29448** |
| **260** | 360 | 60 | 2.1 | 855 000 | 3 850 000 | 1 200 | **29252** |
| | 420 | 95 | 5 | 1 700 000 | 6 800 000 | 800 | **29352** |
| | 480 | 132 | 6 | 2 820 000 | 10 700 000 | 710 | **29452** |
| **280** | 380 | 60 | 2.1 | 885 000 | 4 100 000 | 1 100 | **29256** |
| | 440 | 95 | 5 | 1 830 000 | 7 650 000 | 800 | **29356** |
| | 520 | 145 | 6 | 3 400 000 | 13 100 000 | 630 | **29456** |
| | 520 | 145 | 6 | 3 950 000 | 14 900 000 | 630 | **29456 EM** |
| **300** | 420 | 73 | 3 | 1 160 000 | 5 150 000 | 950 | **29260** |
| | 480 | 109 | 5 | 2 190 000 | 9 100 000 | 710 | **29360** |
| | 540 | 145 | 6 | 3 500 000 | 13 700 000 | 630 | **29460** |
| **320** | 440 | 73 | 3 | 1 190 000 | 5 450 000 | 950 | **29264** |
| | 500 | 109 | 5 | 2 230 000 | 9 400 000 | 670 | **29364** |
| | 580 | 155 | 7.5 | 3 650 000 | 14 600 000 | 560 | **29464** |
| **340** | 460 | 73 | 3 | 1 230 000 | 5 750 000 | 900 | **29268** |
| | 540 | 122 | 5 | 2 640 000 | 11 200 000 | 630 | **29368** |
| | 620 | 170 | 7.5 | 4 400 000 | 17 400 000 | 530 | **29468** |
| **360** | 500 | 85 | 4 | 1 550 000 | 7 300 000 | 800 | **29272** |
| | 560 | 122 | 5 | 2 670 000 | 11 500 000 | 600 | **29372** |
| | 640 | 170 | 7.5 | 4 200 000 | 17 200 000 | 500 | **29472** |
| | 640 | 170 | 7.5 | 5 450 000 | 20 400 000 | 500 | **29472 EM** |
| **380** | 520 | 85 | 4 | 1 620 000 | 7 800 000 | 800 | **29276** |
| | 600 | 132 | 6 | 3 300 000 | 14 500 000 | 560 | **29376** |
| | 670 | 175 | 7.5 | 4 800 000 | 19 500 000 | 480 | **29476** |
| **400** | 540 | 85 | 4 | 1 640 000 | 8 000 000 | 750 | **29280** |
| | 620 | 132 | 6 | 3 250 000 | 14 500 000 | 530 | **29380** |
| | 710 | 185 | 7.5 | 5 400 000 | 22 100 000 | 450 | **29480** |
| **420** | 580 | 95 | 5 | 2 010 000 | 9 800 000 | 670 | **29284** |
| | 650 | 140 | 6 | 3 500 000 | 15 700 000 | 500 | **29384** |
| | 730 | 185 | 7.5 | 5 650 000 | 23 500 000 | 450 | **29484** |

**Note** (1) For heavy load applications, a $d_a$ value should be chosen which is large enough to support the shaft washer rib.

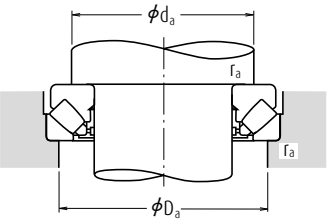
## Dynamic Equivalent Load

$P=1.2F_r+F_a$

## Static Equivalent Load

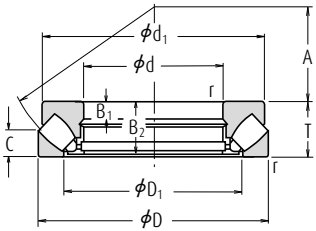
$P_0=2.8F_r+F_a$

However, $F_r/F_a \leq 0.55$ must be satisfied.




| Dimensions (mm) | | | | | | Abutment and Fillet Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|
| $d_1$ | $D_1$ | $B_1$ | $B_2$ | C | A | $d_a$(1) min. | $D_a$ max. | $r_a$ max. | approx. |
| 285 | 254 | 15 | 46 | 24 | 117 | 260 | 275 | 2 | 9.2 |
| 335 | 280 | 29 | 81 | 41 | 125 | 285 | 315 | 3 | 33 |
| 385 | 308 | 43 | 117 | 58 | 132 | 310 | 355 | 5 | 74 |
| 325 | 283 | 19 | 57 | 30 | 130 | 285 | 305 | 2 | 16.5 |
| 355 | 300 | 29 | 81 | 41 | 135 | 300 | 330 | 3 | 35.5 |
| 405 | 326 | 43 | 117 | 59 | 142 | 330 | 375 | 5 | 79 |
| 345 | 302 | 19 | 57 | 30 | 139 | 305 | 325 | 2 | 18 |
| 390 | 329 | 32 | 91 | 45 | 148 | 330 | 365 | 4 | 48.5 |
| 445 | 357 | 48 | 127 | 64 | 154 | 360 | 405 | 5 | 105 |
| 365 | 323 | 19 | 57 | 30 | 150 | 325 | 345 | 2 | 19 |
| 410 | 348 | 32 | 91 | 46 | 158 | 350 | 390 | 4 | 52.5 |
| 480 | 384 | 52 | 140 | 68 | 166 | 390 | 440 | 5 | 132 |
| 480 | 380 | 52 | 140 | 70 | 166 | 410 | 445 | 5 | 134 |
| 400 | 353 | 21 | 69 | 38 | 162 | 355 | 380 | 2.5 | 30 |
| 450 | 379 | 37 | 105 | 50 | 168 | 380 | 420 | 4 | 74 |
| 500 | 402 | 52 | 140 | 70 | 175 | 410 | 460 | 5 | 140 |
| 420 | 372 | 21 | 69 | 38 | 172 | 375 | 400 | 2.5 | 32.5 |
| 470 | 399 | 37 | 105 | 53 | 180 | 400 | 440 | 4 | 77 |
| 555 | 436 | 55 | 149 | 75 | 191 | 435 | 495 | 6 | 175 |
| 440 | 395 | 21 | 69 | 37 | 183 | 395 | 420 | 2.5 | 33.5 |
| 510 | 428 | 41 | 117 | 59 | 192 | 430 | 470 | 4 | 103 |
| 590 | 462 | 61 | 164 | 82 | 201 | 465 | 530 | 6 | 218 |
| 480 | 423 | 25 | 81 | 44 | 194 | 420 | 455 | 3 | 51 |
| 525 | 448 | 41 | 117 | 59 | 202 | 450 | 495 | 4 | 107 |
| 610 | 480 | 61 | 164 | 82 | 210 | 485 | 550 | 6 | 228 |
| 580 | 474 | 61 | 164 | 83 | 210 | 495 | 550 | 6 | 220 |
| 496 | 441 | 27 | 81 | 42 | 202 | 440 | 475 | 3 | 52 |
| 568 | 477 | 44 | 127 | 63 | 216 | 480 | 525 | 5 | 140 |
| 640 | 504 | 63 | 168 | 85 | 230 | 510 | 575 | 6 | 254 |
| 517 | 460 | 27 | 81 | 42 | 212 | 460 | 490 | 3 | 55 |
| 590 | 494 | 44 | 127 | 64 | 225 | 500 | 550 | 5 | 150 |
| 680 | 536 | 67 | 178 | 89 | 236 | 540 | 610 | 6 | 306 |
| 553 | 489 | 30 | 91 | 46 | 225 | 490 | 525 | 4 | 72 |
| 620 | 520 | 48 | 135 | 68 | 235 | 525 | 575 | 5 | 170 |
| 700 | 556 | 67 | 178 | 89 | 244 | 560 | 630 | 6 | 323 |

## Bore Diameter 440 – 500 mm




| Boundary Dimensions (mm) | | | | Basic Load Ratings (N) | | Limiting Speeds (min⁻¹) | Bearing Numbers |
|---|---|---|---|---|---|---|---|
| d | D | T | r min. | $C_a$ | $C_{0a}$ | Oil | |
| **440** | 600 | 95 | 5 | 2 030 000 | 10 100 000 | 670 | **29288** |
| | 680 | 145 | 6 | 3 750 000 | 16 700 000 | 480 | **29388** |
| | 780 | 206 | 9.5 | 6 550 000 | 27 200 000 | 400 | **29488** |
| | 780 | 206 | 9.5 | 8 000 000 | 31 500 000 | 400 | **29488 EM** |
| **460** | 620 | 95 | 5 | 2 060 000 | 10 300 000 | 670 | **29292** |
| | 710 | 150 | 6 | 4 100 000 | 18 400 000 | 450 | **29392** |
| | 800 | 206 | 9.5 | 6 750 000 | 28 600 000 | 380 | **29492** |
| **480** | 650 | 103 | 5 | 2 370 000 | 12 100 000 | 600 | **29296** |
| | 730 | 150 | 6 | 4 150 000 | 19 000 000 | 450 | **29396** |
| | 850 | 224 | 9.5 | 7 200 000 | 31 000 000 | 360 | **29496** |
| **500** | 670 | 103 | 5 | 2 390 000 | 12 400 000 | 600 | **292/500** |
| | 750 | 150 | 6 | 4 350 000 | 20 400 000 | 450 | **293/500** |
| | 870 | 224 | 9.5 | 7 850 000 | 33 000 000 | 340 | **294/500** |

**Note** (1) For heavy load applications, a $d_a$ value should be chosen which is large enough to support the shaft washer rib.

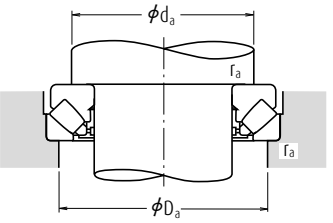
## Dynamic Equivalent Load

$P=1.2F_r+F_a$

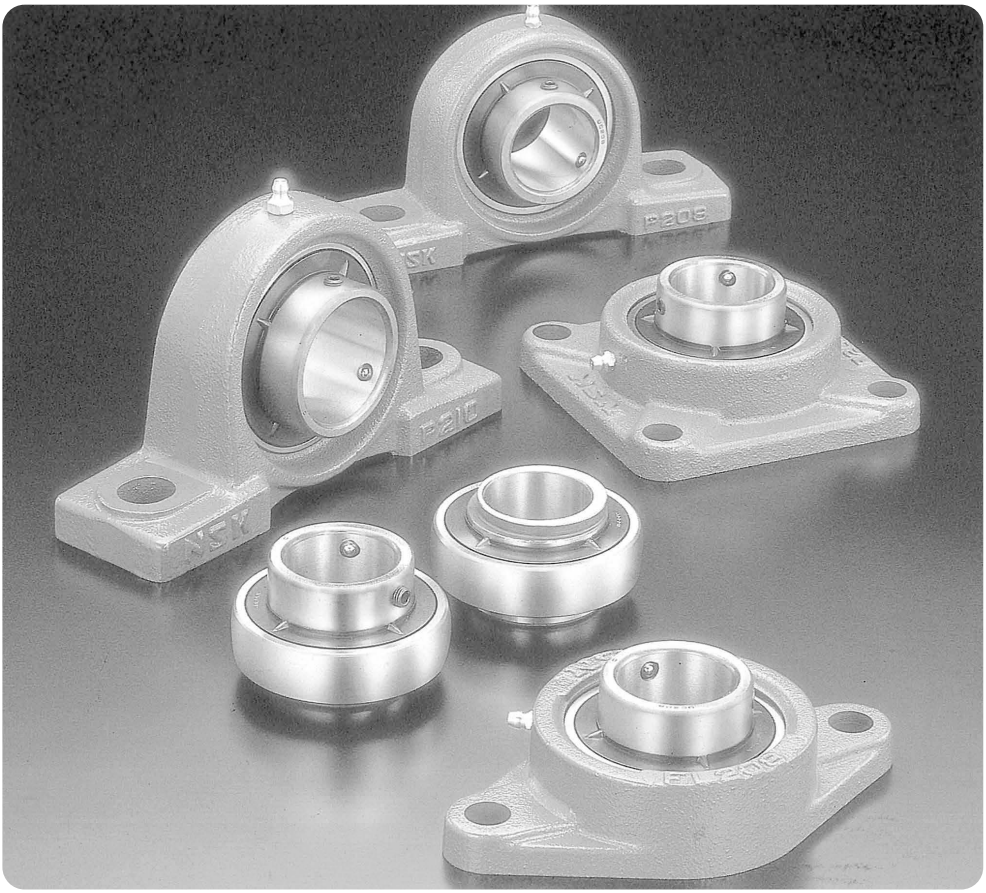
## Static Equivalent Load

$P_0=2.8F_r+F_a$

However, $F_r/F_a \leq 0.55$ must be satisfied.




| Dimensions (mm) | | | | | | Abutment and Fillet Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|
| $d_1$ | $D_1$ | $B_1$ | $B_2$ | C | A | $d_a$(1) min. | $D_a$ max. | $r_a$ max. | approx. |
| 575 | 508 | 30 | 91 | 49 | 235 | 510 | 545 | 4 | 77 |
| 645 | 548 | 49 | 140 | 70 | 245 | 550 | 600 | 5 | 190 |
| 745 | 588 | 74 | 199 | 100 | 260 | 595 | 670 | 8 | 407 |
| 710 | 577 | 74 | 199 | 101 | 257 | 605 | 675 | 8 | 402 |
| 592 | 530 | 30 | 91 | 46 | 245 | 530 | 570 | 4 | 80 |
| 666 | 567 | 51 | 144 | 72 | 257 | 575 | 630 | 5 | 210 |
| 765 | 608 | 74 | 199 | 100 | 272 | 615 | 690 | 8 | 420 |
| 624 | 556 | 33 | 99 | 55 | 259 | 555 | 595 | 4 | 97 |
| 690 | 590 | 51 | 144 | 72 | 270 | 595 | 650 | 5 | 215 |
| 810 | 638 | 81 | 216 | 108 | 280 | 645 | 730 | 8 | 545 |
| 645 | 574 | 33 | 99 | 55 | 268 | 575 | 615 | 4 | 100 |
| 715 | 611 | 51 | 144 | 74 | 280 | 615 | 670 | 5 | 220 |
| 830 | 661 | 81 | 216 | 107 | 290 | 670 | 750 | 8 | 560 |



## 12. BALL BEARING UNITS

### DESIGN AND TYPES

For ball bearing units, there are many designs and types.
Please refer to specified Catalog below, for more detailed information.
Specified Catalog

- Ball Bearing Units CAT.No. E1154
- Ball Bearing Units Steel Series CAT.No. E1232
- Ball Bearing Units with Ductile Cast Iron Housing CAT.No. E1233
- Triple-Sealed Bearings for Ball Bearing Units CAT.No. E1234
- Ball Bearings Units Stainless Series CAT.No. E1235
- Ball Bearing Units Hand book CAT.No. E1155

## SNN SERIES AND SD SERIES



| | Shaft Dia. | Page |
|---|---|---|
| Plummer Blocks SNN 500 - 600 Series | 20 – 65 mm | B 368 |
| | 70 – 140 mm | B 370 |
| Plummer Blocks SD 3100 Serie | 150 – 380 mm | B 372 |


## Housing Features – Designation

The plummer block housings detailed in this brochure are manufactured in accordance with ISO/R113 standards.

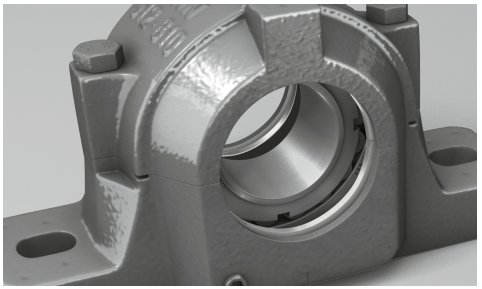
**Bearing Nomenclature**

**Example:** SNN 511 - 609

Housing design code

Size

Size



## Housings Features

- Colour: RAL 7001, Pantone 444C
- Housing Material: Cast Iron Grade 200
- Cap bolts: Mild steel AISI1010 Grade 8.8
- Metal plugs: Mild steel AISI 1010
- Tolerance of bearing seating: H7
- The bearing seating is protected against corrosion, all the non machined internal parts are primed.
- Each housing is supplied with a straight grease nipple (see dimensions in the lubrication section).
- Each SNN housing is supplied with 2 lubrication holes on the cap and 1 drain hole on the base.

## Housings Designation

500 Series
for light series bearings with tapered bore
1200K, 2200K, 22200K, 23200K

600 Series
for medium series bearings with tapered bore
1300K, 2300K, 21300K, 22300K

The SNN 500 and 600 series comprise a number of housings which, when combined with different seal options and ball or spherical roller bearings, provide an answer for most plummer block applications with shaft diameters ranging from 20 mm to 140 mm.

## Plummer blocks typical arrangement

Fig. 1

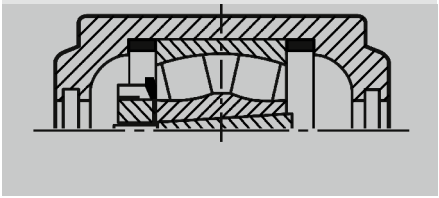


Fig. 1:

In the fixed plummer block, to prevent axial displacement of the bearing, 2 locating rings are installed, one on either side of the bearing.

Locating Rings are manufactured in aluminium.

Fig. 2

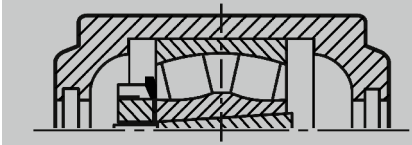


Fig 2:

One bearing should be free to move axially.
This plummer block should not be assembled with locating rings.

## How to order SNN complete Plummer Blocks from NSK

### Example 1 – Application with 2 plummer blocks

Free end

Through shaft diam 50 mm, equiped with 1 spherical roller bearing 22211EAK, double lip seals on both sides.

Parts required:

- 1 NSK housing SNN511-609
- 1 NSK bearing 22211EAKE4
- 1 NSK adapter sleeve H311
- 1 seal pack G511-KIT (2 seals included)

Fixed end

Shaft end, diam 50 mm, equiped with 1 spherical roller bearing 22211EAK, double lip seal on 1 side.

Parts required:

- 1 NSK housing SNN511-609
- 1 NSK bearing 22211EAKE4
- 1 NSK adapter sleeve H311
- 1 locating ring kit SR100/9.5-KIT (2 rings included)
- 1 seal pack G511-KIT (2 seals included)
- 1 end cover 511A

### Example 2 – Application with 2 plummer blocks

Free end

Through shaft diam 75 mm, equiped with 1 spherical roller bearing 22217EAK, labyrinth seals on both sides.

Parts required:

- 1 NSK housing SNN517
- 1 NSK bearing 22217EAKE4
- 1 NSK adapter sleeve H317
- 2 seals TS517U (the kit includes 1 labyrinth and o-ring)

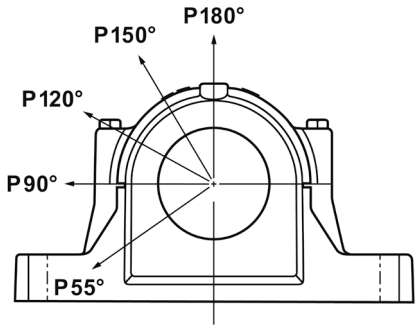
Fixed end

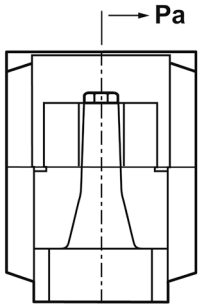
Shaft end, diam 75 mm, equiped with 1 spherical roller bearing 22217EAK, labyrinth seal on 1 side.

Parts required:

- 1 NSK housing SNN517
- 1 NSK bearing 22217EAKE4
- 1 NSK adapter sleeve H317
- 1 locating ring kit SR150/12.5-KIT (2 rings included)
- 1 seal TS517U (the kit includes 1 labyrinth and o-ring)
- 1 end cover 517A

## Breaking Loads for SNN Housings




| Housing No. | | Breaking Load (kN) | | | | | | Max. Loads of the two cap bolts (kN) |
|---|---|---|---|---|---|---|---|---|
| | | Pa | P55° | P90° | P120° | P150° | P180° | P180° |
| **SNN** | 505 | 52 | 155 | 95 | 70 | 60 | 80 | 25 |
| **SNN** | 506-605 | 55 | 170 | 100 | 80 | 65 | 85 | 25 |
| **SNN** | 507-606 | 60 | 190 | 115 | 85 | 80 | 95 | 25 |
| **SNN** | 508-607 | 70 | 215 | 130 | 95 | 85 | 110 | 25 |
| **SNN** | 509 | 75 | 230 | 140 | 100 | 90 | 115 | 25 |
| **SNN** | 510-608 | 85 | 265 | 155 | 120 | 110 | 130 | 25 |
| **SNN** | 511-609 | 90 | 275 | 170 | 125 | 115 | 140 | 40 |
| **SNN** | 512-610 | 100 | 300 | 180 | 130 | 120 | 150 | 40 |
| **SNN** | 513-611 | 110 | 340 | 205 | 150 | 130 | 170 | 40 |
| **SNN** | 515-612 | 135 | 410 | 250 | 185 | 160 | 205 | 40 |
| **SNN** | 516-613 | 140 | 430 | 260 | 190 | 175 | 215 | 40 |
| **SNN** | 517 | 155 | 480 | 290 | 205 | 190 | 240 | 40 |
| **SNN** | 518-615 | 180 | 550 | 340 | 250 | 215 | 275 | 85 |
| **SNN** | 519-616 | 190 | 580 | 350 | 260 | 230 | 290 | 85 |
| **SNN** | 520-617 | 200 | 620 | 370 | 280 | 250 | 310 | 130 |
| **SNN** | 522-619 | 220 | 680 | 410 | 310 | 275 | 340 | 130 |
| **SNN** | 524-620 | 260 | 790 | 470 | 350 | 320 | 400 | 130 |
| **SNN** | 526 | 295 | 900 | 540 | 410 | 360 | 450 | 190 |
| **SNN** | 528 | 345 | 1050 | 630 | 470 | 430 | 530 | 190 |
| **SNN** | 530 | 390 | 1200 | 730 | 540 | 480 | 600 | 190 |
| **SNN** | 532 | 470 | 1450 | 860 | 640 | 570 | 720 | 190 |

Cap bolt material: Grade 8.8
Reference values only

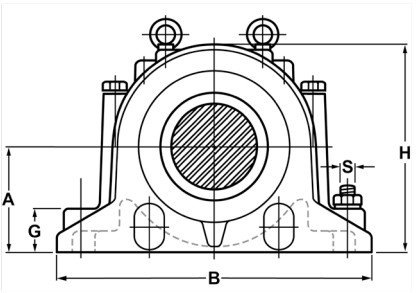
# Cap & Fixing Bolts Sizes – Recommended Tightening Torques

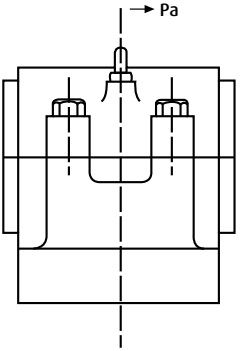
| SNN Housing | Cap Bolt Size Grade 8.8 | Recommended max. Tightening Torque | Base Bolts Size Grade 8.8 | Recommended max. Tightening Torque |
|---|---|---|---|---|
| | | Nm | | Nm |
| **SNN505** | M10 | 50 | M12 | 80 |
| **SNN506-605** | M10 | 50 | M12 | 80 |
| **SNN507-606** | M10 | 50 | M12 | 80 |
| **SNN508-607** | M10 | 50 | M12 | 80 |
| **SNN509** | M10 | 50 | M12 | 80 |
| **SNN510-608** | M10 | 50 | M12 | 80 |
| **SNN511-609** | M12 | 80 | M16 | 200 |
| **SNN512-610** | M12 | 80 | M16 | 200 |
| **SNN513-609** | M12 | 80 | M16 | 200 |
| **SNN515-612** | M12 | 80 | M16 | 200 |
| **SNN516-613** | M16 | 150 | M20 | 385 |
| **SNN517** | M16 | 150 | M20 | 385 |
| **SNN518-615** | M16 | 150 | M20 | 385 |
| **SNN519-616** | M16 | 150 | M20 | 385 |
| **SNN520-617** | M20 | 200 | M24 | 665 |
| **SNN522-619** | M20 | 200 | M24 | 665 |
| **SNN524-620** | M20 | 200 | M24 | 665 |
| **SNN526** | M24 | 350 | M24 | 665 |
| **SNN528** | M24 | 350 | M30 | 1310 |
| **SNN530** | M24 | 350 | M30 | 1310 |
| **SNN532** | M24 | 350 | M30 | 1310 |

## BOLT SIZE AND BREAKING LOADS



Plummer blocks of series SD3100 are used with large spherical roller bearings of series 23100 with tapered bore on adapter sleeves.




**Material:** Cast Iron Grade 200
**Colour:** Dark Blue 533C
**Cap bolts grade:** 8.8
(size: see table below)

Supplied with 1 straight grease nipple

**Tolerance of bearing seating:** H7
**Draining hole:** 1/4PT

SD 3100 Bolt Size

| Housing | Bolt Size |
|---|---|
| **SD3134TS/TAC** | M20*2.5P*140LG |
| **SD3136TS/TAC** | M24*3.0P*140LG |
| **SD3138TS/TAC** | M24*3.0P*140LG |
| **SD3140TS/TAC** | M24*3.0P*170LG |
| **SD3144TS/TAC** | M24*3.0P*170LG |
| **SD3148TS/TAC** | M30*3.5P*200LG |
| **SD3152TS/TAC** | M30*3.5P*200LG |
| **SD3156TS/TAC** | M30*3.5P*210LG |
| **SD3160TS/TAC** | M30*3.5P*220LG |
| **SD3164TS/TAC** | M30*3.5P*220LG |
| **SD3168TS/TAC** | M36*4.0P*260LG |
| **SD3172TS/TAC** | M36*4.0P*280LG |
| **SD3176TS/TAC** | M36*4.0P*280LG |
| **SD3180TS/TAC** | M36*4.0P*310LG |

Breaking Loads of SD Housings

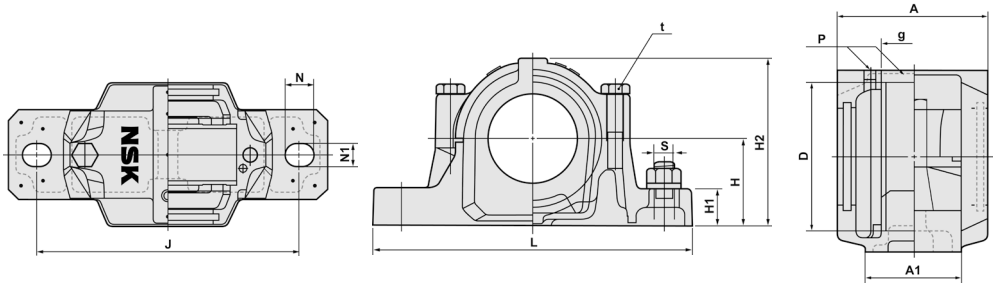
| Housing No. | | Breaking Load (kN) | | | | | Max. Load of Cap Bolts (kN) |
|---|---|---|---|---|---|---|---|
| | | P55° | P90° | P120° | P150° | P180° | P180° |
| **SD** | 3134 | 2273 | 1016 | 762 | 747 | 846 | 380 |
| **SD** | 3136 | 2540 | 1150 | 850 | 835 | 946 | 380 |
| **SD** | 3138 | 2941 | 1300 | 1020 | 966 | 1095 | 380 |
| **SD** | 3140 | 3476 | 1600 | 1165 | 1143 | 1296 | 380 |
| **SD** | 3144 | 4280 | 1900 | 1435 | 1407 | 1594 | 380 |
| **SD** | 3148 | 4548 | 2000 | 1524 | 1495 | 1694 | 620 |
| **SD** | 3152 | 5083 | 2300 | 1703 | 1670 | 1893 | 620 |
| **SD** | 3156 | 5350 | 2400 | 1810 | 1760 | 1993 | 620 |
| **SD** | 3160 | 6420 | 2900 | 2215 | 2110 | 2390 | 620 |
| **SD** | 3164 | 7490 | 3400 | 2525 | 2400 | 2790 | 620 |
| **SD** | 3168 | 9320 | 4200 | 3260 | 3050 | 3490 | 800 |
| **SD** | 3172 | 9750 | 4400 | 3370 | 3200 | 3690 | 800 |
| **SD** | 3176 | 10230 | 4550 | 3500 | 3320 | 3710 | 800 |
| **SD** | 3180 | 10720 | 4800 | 3770 | 3560 | 4000 | 800 |

Reference values only

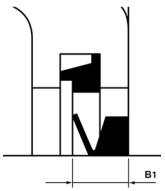
**Note** Housings for Taconite seals (TAC) on request

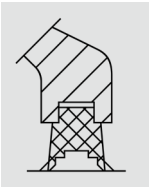
# Plummer Blocks SNN 500 - 600 Series

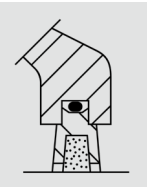
## Shaft Diameter 20 – 65 mm

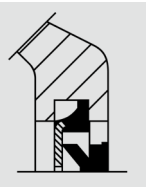


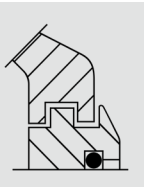

| Shaft Diam. D (mm) | Bearing | | Adapter Sleeve | Locating Ring Kit (2 rings) | Housing Designation | D (mm) | H (mm) | J (mm) | A (mm) | L (mm) | A1 (mm) | H1 (mm) | H2 (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ball | Roller | | | | | | | | | | | |
| **20** | 1205K | – | H205 | SR52x5 | SNN505 | 52 | 40 | 130 | 70 | 165 | 46 | 22 | 73 |
| | 2205K | 22205K | H305 | SR52x3.5 | SNN505 | 52 | 40 | 130 | 70 | 165 | 46 | 22 | 73 |
| | 1305K | 21305K | H305 | SR62x7.5 | SNN506-605 | 62 | 50 | 150 | 80 | 185 | 52 | 22 | 88 |
| | 2305K | – | H2305 | SR62x4 | SNN506-605 | 62 | 50 | 150 | 80 | 185 | 52 | 22 | 88 |
| **25** | 1206K | – | H206 | SR62x8 | SNN506-605 | 62 | 50 | 150 | 80 | 185 | 52 | 22 | 88 |
| | 2206K | 22206K | H306 | SR62x6 | SNN506-605 | 62 | 50 | 150 | 80 | 185 | 52 | 22 | 88 |
| | 1306K | 21306K | H306 | SR72x7.5 | SNN507-606 | 72 | 50 | 150 | 85 | 185 | 52 | 22 | 93 |
| | 2306K | – | H2306 | SR72x3.5 | SNN507-606 | 72 | 50 | 150 | 85 | 185 | 52 | 22 | 93 |
| **30** | 1207K | – | H207 | SR72x8.5 | SNN507-606 | 72 | 50 | 150 | 85 | 185 | 52 | 22 | 93 |
| | 2207K | 22207K | H307 | SR72x5.5 | SNN507-606 | 72 | 50 | 150 | 85 | 185 | 52 | 22 | 93 |
| | 1307K | 21307K | H307 | SR80x9 | SNN508-607 | 80 | 60 | 170 | 90 | 205 | 60 | 25 | 107 |
| | 2307K | – | H2307 | SR80x4 | SNN508-607 | 80 | 60 | 170 | 90 | 205 | 60 | 25 | 107 |
| **35** | 1208K | – | H208 | SR80x10.5 | SNN508-607 | 80 | 60 | 170 | 90 | 205 | 60 | 25 | 107 |
| | 2208K | 22208K | H308 | SR80x8 | SNN508-607 | 80 | 60 | 170 | 90 | 205 | 60 | 25 | 107 |
| | 1308K | 21308K | H308 | SR90x9 | SNN510-608 | 90 | 60 | 170 | 95 | 205 | 60 | 25 | 113 |
| | 2308K | 22308K | H2308 | SR90x4 | SNN510-608 | 90 | 60 | 170 | 95 | 205 | 60 | 25 | 113 |
| **40** | 1209K | – | H209 | SR85x5.5 | SNN509 | 85 | 60 | 170 | 90 | 205 | 60 | 25 | 111 |
| | 2209K | 22209K | H309 | SR85x3.5 | SNN509 | 85 | 60 | 170 | 90 | 205 | 60 | 25 | 111 |
| | 1309K | 21309K | H309 | SR100x9.5 | SNN511-609 | 100 | 70 | 210 | 100 | 255 | 70 | 28 | 129 |
| | 2309K | 22309K | H2309 | SR100x4 | SNN511-609 | 100 | 70 | 210 | 100 | 255 | 70 | 28 | 129 |
| **45** | 1210K | – | H210 | SR90x10.5 | SNN510-608 | 90 | 60 | 170 | 95 | 205 | 60 | 25 | 113 |
| | 2210K | 22210K | H310 | SR90x9 | SNN510-608 | 90 | 60 | 170 | 95 | 205 | 60 | 25 | 113 |
| | 1310K | 21310K | H310 | SR110x10.5 | SNN512-610 | 110 | 70 | 210 | 110 | 255 | 70 | 30 | 134 |
| | 2310K | 22310K | H2310 | SR110x4 | SNN512-610 | 110 | 70 | 210 | 110 | 255 | 70 | 30 | 134 |
| **50** | 1211K | – | H211 | SR100x11.5 | SNN511-609 | 100 | 70 | 210 | 100 | 255 | 70 | 28 | 129 |
| | 2211K | 22211K | H311 | SR100x9.5 | SNN511-609 | 100 | 70 | 210 | 100 | 255 | 70 | 28 | 129 |
| | 1311K | 21311K | H311 | SR120x11 | SNN513-611 | 120 | 80 | 230 | 115 | 275 | 80 | 30 | 150 |
| | 2311K | 22311K | H2311 | SR120x4 | SNN513-611 | 120 | 80 | 230 | 115 | 275 | 80 | 30 | 150 |
| **55** | 1212K | – | H212 | SR110x13 | SNN512-610 | 110 | 70 | 210 | 110 | 255 | 70 | 30 | 134 |
| | 2212K | 22212K | H312 | SR110x10 | SNN512-610 | 110 | 70 | 210 | 110 | 255 | 70 | 30 | 134 |
| | 1312K | 21312K | H312 | SR130x12.5 | SNN515-612 | 130 | 80 | 230 | 120 | 280 | 80 | 30 | 155 |
| | 2312K | 22312K | H2312 | SR130x5 | SNN515-612 | 130 | 80 | 230 | 120 | 280 | 80 | 30 | 155 |
| **60** | 1213K | – | H213 | SR120x14 | SNN513-611 | 120 | 80 | 230 | 115 | 275 | 80 | 30 | 150 |
| | 2213K | 22213K | H313 | SR120x10 | SNN513-611 | 120 | 80 | 230 | 115 | 275 | 80 | 30 | 150 |
| | 1313K | 21313K | H313 | SR140x12.5 | SNN516-613 | 140 | 95 | 260 | 130 | 315 | 90 | 32 | 175 |
| | 2313K | 22313K | H2313 | SR140x5 | SNN516-613 | 140 | 95 | 260 | 130 | 315 | 90 | 32 | 175 |
| **65** | 1215K | – | H215 | SR130x15.5 | SNN515-612 | 130 | 80 | 230 | 120 | 280 | 80 | 30 | 155 |
| | 2215K | 22215K | H315 | SR130x12.5 | SNN515-612 | 130 | 80 | 230 | 120 | 280 | 80 | 30 | 155 |
| | 1315K | 21315K | H315 | SR160x14 | SNN518-615 | 160 | 100 | 290 | 145 | 345 | 100 | 35 | 193 |
| | 2315K | 22315K | H2315 | SR160x5 | SNN518-615 | 160 | 100 | 290 | 145 | 345 | 100 | 35 | 193 |

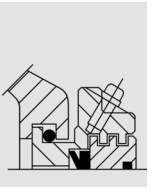




G Seals


C Seals


V Seals

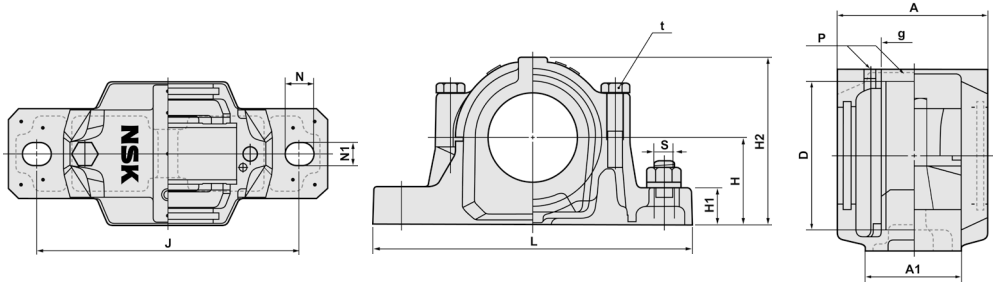

TS-U Seals


TACK Seals

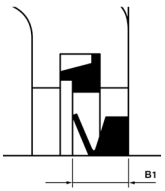
| g (mm) | t (mm) | N (mm) | N1 (mm) | s (mm) | P | G Seals KIT | C Seals KIT | V Seals KIT (B1: Fitted Width) | TS-U Seals | TACK Seals | End Cover | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | M10 | 20 | 15 | M12 | R1/8 | G505-KIT | C505-KIT | V505-KIT (6 ±0.8) | TS505U | TACK505 | 505A | 1.45 |
| 25 | M10 | 20 | 15 | M12 | R1/8 | G505-KIT | C505-KIT | V505-KIT (6 ±0.8) | TS505U | TACK505 | 505A | 1.45 |
| 32 | M10 | 20 | 15 | M12 | R1/8 | G605-KIT | C605-KIT | V605-KIT (6 ±0.8) | TS605U | TACK605 | 505A | 2.00 |
| 32 | M10 | 20 | 15 | M12 | R1/8 | G605-KIT | C605-KIT | V605-KIT (6 ±0.8) | TS605U | TACK605 | 505A | 2.00 |
| 32 | M10 | 20 | 15 | M12 | R1/8 | G506-KIT | C506-KIT | V506-KIT (6 ±0.8) | TS506U | TACK506 | 506A | 2.00 |
| 32 | M10 | 20 | 15 | M12 | R1/8 | G506-KIT | C506-KIT | V506-KIT (6 ±0.8) | TS506U | TACK506 | 506A | 2.00 |
| 34 | M10 | 20 | 15 | M12 | R1/8 | G606-KIT | C606-KIT | V606-KIT (6 ±0.8) | TS606U | TACK606 | 507A | 2.20 |
| 34 | M10 | 20 | 15 | M12 | R1/8 | G606-KIT | C606-KIT | V606-KIT (6 ±0.8) | TS606U | TACK606 | 507A | 2.20 |
| 34 | M10 | 20 | 15 | M12 | R1/8 | G507-KIT | C507-KIT | V507-KIT (6 ±0.8) | TS507U | TACK507 | 507A | 2.20 |
| 34 | M10 | 20 | 15 | M12 | R1/8 | G507-KIT | C507-KIT | V507-KIT (6 ±0.8) | TS507U | TACK507 | 507A | 2.20 |
| 39 | M10 | 20 | 15 | M12 | R1/8 | G607-KIT | C607-KIT | V607-KIT (6 ±0.8) | TS607U | TACK607 | 508A | 2.90 |
| 39 | M10 | 20 | 15 | M12 | R1/8 | G607-KIT | C607-KIT | V607-KIT (6 ±0.8) | TS607U | TACK607 | 508A | 2.90 |
| 39 | M10 | 20 | 15 | M12 | R1/8 | G508-KIT | C508-KIT | V508-KIT (6 ±0.8) | TS508U | TACK508 | 508A | 2.90 |
| 39 | M10 | 20 | 15 | M12 | R1/8 | G508-KIT | C508-KIT | V508-KIT (6 ±0.8) | TS508U | TACK508 | 508A | 2.90 |
| 41 | M10 | 20 | 15 | M12 | R1/8 | G608-KIT | C608-KIT | V608-KIT (6 ±0.8) | TS608U | TACK608 | 510A | 3.10 |
| 41 | M10 | 20 | 15 | M12 | R1/8 | G608-KIT | C608-KIT | V608-KIT (6 ±0.8) | TS608U | TACK608 | 510A | 3.10 |
| 30 | M10 | 20 | 15 | M12 | R1/8 | G509-KIT | C509-KIT | V509-KIT (7 ±1) | TS509U | TACK509 | 509A | 3.00 |
| 30 | M10 | 20 | 15 | M12 | R1/8 | G509-KIT | C509-KIT | V509-KIT (7 ±1) | TS509U | TACK509 | 509A | 3.00 |
| 44 | M12 | 24 | 18 | M16 | R1/8 | G609-KIT | C609-KIT | V609-KIT (7 ±1) | TS609U | TACK609 | 511A | 4.80 |
| 44 | M12 | 24 | 18 | M16 | R1/8 | G609-KIT | C609-KIT | V609-KIT (7 ±1) | TS609U | TACK609 | 511A | 4.80 |
| 41 | M10 | 20 | 15 | M12 | R1/8 | G510-KIT | C510-KIT | V510-KIT (7 ±1) | TS510U | TACK510 | 510A | 3.10 |
| 41 | M10 | 20 | 15 | M12 | R1/8 | G510-KIT | C510-KIT | V510-KIT (7 ±1) | TS510U | TACK510 | 510A | 3.10 |
| 48 | M12 | 24 | 18 | M16 | R1/8 | G610-KIT | C610-KIT | V610-KIT (7 ±1) | TS610U | TACK610 | 512A | 5.40 |
| 48 | M12 | 24 | 18 | M16 | R1/8 | G610-KIT | C610-KIT | V610-KIT (7 ±1) | TS610U | TACK610 | 512A | 5.40 |
| 44 | M12 | 24 | 18 | M16 | R1/8 | G511-KIT | C511-KIT | V511-KIT (7 ±1) | TS511U | TACK511 | 511A | 4.80 |
| 44 | M12 | 24 | 18 | M16 | R1/8 | G511-KIT | C511-KIT | V511-KIT (7 ±1) | TS511U | TACK511 | 511A | 4.80 |
| 51 | M12 | 24 | 18 | M16 | R1/8 | G611-KIT | C611-KIT | V611-KIT (7 ±1) | TS611U | TACK611 | 513A | 6.60 |
| 51 | M12 | 24 | 18 | M16 | R1/8 | G611-KIT | C611-KIT | V611-KIT (7 ±1) | TS611U | TACK611 | 513A | 6.60 |
| 48 | M12 | 24 | 18 | M16 | R1/8 | G512-KIT | C512-KIT | V512-KIT (7 ±1) | TS512U | TACK512 | 512A | 5.40 |
| 48 | M12 | 24 | 18 | M16 | R1/8 | G512-KIT | C512-KIT | V512-KIT (7 ±1) | TS512U | TACK512 | 512A | 5.40 |
| 56 | M12 | 24 | 18 | M16 | R1/8 | G612-KIT | C612-KIT | V612-KIT (7 ±1) | TS612U | TACK612 | 515A | 6.80 |
| 56 | M12 | 24 | 18 | M16 | R1/8 | G612-KIT | C612-KIT | V612-KIT (7 ±1) | TS612U | TACK612 | 515A | 6.80 |
| 51 | M12 | 24 | 18 | M16 | R1/8 | G513-KIT | C513-KIT | V513-KIT (7 ±1) | TS513U | TACK513 | 513A | 6.60 |
| 51 | M12 | 24 | 18 | M16 | R1/8 | G513-KIT | C513-KIT | V513-KIT (7 ±1) | TS513U | TACK513 | 513A | 6.60 |
| 58 | M16 | 28 | 22 | M20 | R1/4 | G613-KIT | C613-KIT | V613-KIT (7 ±1) | TS613U | TACK613 | 516A | 10.20 |
| 58 | M16 | 28 | 22 | M20 | R1/4 | G613-KIT | C613-KIT | V613-KIT (7 ±1) | TS613U | TACK613 | 516A | 10.20 |
| 56 | M12 | 24 | 18 | M16 | R1/8 | G515-KIT | C515-KIT | V515-KIT (7 ±1) | TS515U | TACK515 | 515A | 6.80 |
| 56 | M12 | 24 | 18 | M16 | R1/8 | G515-KIT | C515-KIT | V515-KIT (7 ±1) | TS515U | TACK515 | 515A | 6.80 |
| 65 | M16 | 28 | 22 | M20 | R1/4 | G615-KIT | C615-KIT | V615-KIT (7 ±1) | TS615U | TACK615 | 518A | 13.00 |
| 65 | M16 | 28 | 22 | M20 | R1/4 | G615-KIT | C615-KIT | V615-KIT (7 ±1) | TS615U | TACK615 | 518A | 13.00 |

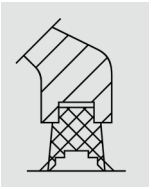
# Plummer Blocks SNN 500 - 600 Series

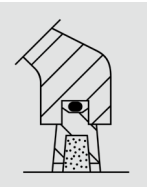
## Shaft Diameter 70 – 140 mm

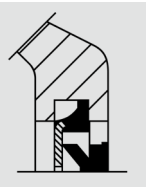


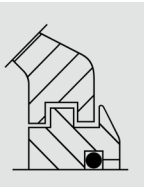

| Shaft Diam. D (mm) | Bearing | | Adapter Sleeve | Locating Ring Kit (2 rings) | Housing Designation | D (mm) | H (mm) | J (mm) | A (mm) | L (mm) | A1 (mm) | H1 (mm) | H2 (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ball | Roller | | | | | | | | | | | |
| **70** | 1216K | – | H216 | SR140x16 | SNN516-613 | 140 | 95 | 260 | 130 | 315 | 90 | 32 | 175 |
| | 2216K | 22216K | H316 | SR140x12.5 | SNN516-613 | 140 | 95 | 260 | 130 | 315 | 90 | 32 | 175 |
| | 1316K | 21316K | H316 | SR170x14.5 | SNN519-616 | 170 | 112 | 290 | 145 | 345 | 100 | 35 | 210 |
| | 2316K | 22316K | H2316 | SR170x5 | SNN519-616 | 170 | 112 | 290 | 145 | 345 | 100 | 35 | 210 |
| **75** | 1217K | – | H217 | SR150x16.5 | SNN517 | 150 | 95 | 260 | 135 | 320 | 90 | 32 | 183 |
| | 2217K | 22217K | H317 | SR150x12.5 | SNN517 | 150 | 95 | 260 | 135 | 320 | 90 | 32 | 183 |
| | 1317K | 21317K | H317 | SR180x14.5 | SNN520-617 | 180 | 112 | 320 | 160 | 380 | 110 | 40 | 215 |
| | 2317K | 22317K | H2317 | SR180x5 | SNN520-617 | 180 | 112 | 320 | 160 | 380 | 110 | 40 | 215 |
| **80** | 1218K | – | H218 | SR160x17.5 | SNN518-615 | 160 | 100 | 290 | 145 | 345 | 100 | 35 | 193 |
| | 2218K | 22218K | H318 | SR160x12.5 | SNN518-615 | 160 | 100 | 290 | 145 | 345 | 100 | 35 | 193 |
| | – | 23218K | H2318 | SR160x6.25 | SNN518-615 | 160 | 100 | 290 | 145 | 345 | 100 | 35 | 193 |
| **85** | 1219K | – | H219 | SR170x18 | SNN519-616 | 170 | 112 | 290 | 145 | 345 | 100 | 35 | 210 |
| | 2219K | 22219K | H319 | SR170x12.5 | SNN519-616 | 170 | 112 | 290 | 145 | 345 | 100 | 35 | 210 |
| | 1319K | 21319K | H319 | SR200x17.5 | SNN522-619 | 200 | 125 | 350 | 175 | 410 | 120 | 45 | 240 |
| | 2319K | 22319K | H2319 | SR200x6.5 | SNN522-619 | 200 | 125 | 350 | 175 | 410 | 120 | 45 | 240 |
| **90** | 1220K | – | H220 | SR180x18 | SNN520-617 | 180 | 112 | 320 | 160 | 380 | 110 | 40 | 215 |
| | 2220K | 22220K | H320 | SR180x12 | SNN520-617 | 180 | 112 | 320 | 160 | 380 | 110 | 40 | 215 |
| | – | 23220K | H2320 | SR180x4.75 | SNN520-617 | 180 | 112 | 320 | 160 | 380 | 110 | 40 | 215 |
| | 1320K | 21320K | H320 | SR215x19.5 | SNN524-620 | 215 | 140 | 350 | 185 | 410 | 120 | 45 | 271 |
| | 2320K | 22320K | H2320 | SR215x6.5 | SNN524-620 | 215 | 140 | 350 | 185 | 410 | 120 | 45 | 271 |
| **100** | 1222K | – | H222 | SR200x21 | SNN522-619 | 200 | 125 | 350 | 175 | 410 | 120 | 45 | 240 |
| | 2222K | 22222K | H322 | SR200x13.5 | SNN522-619 | 200 | 125 | 350 | 175 | 410 | 120 | 45 | 240 |
| | – | 23222K | H2322 | SR200x5 | SNN522-619 | 200 | 125 | 350 | 175 | 410 | 120 | 45 | 240 |
| **110** | – | 22224K | H3124 | SR215x14 | SNN524-620 | 215 | 140 | 350 | 185 | 410 | 120 | 45 | 271 |
| | – | 23224K | H2324 | SR215x5 | SNN524-620 | 215 | 140 | 350 | 185 | 410 | 120 | 45 | 271 |
| **115** | – | 22226K | H3126 | SR230x13 | SNN526 | 230 | 150 | 380 | 190 | 445 | 130 | 50 | 288 |
| | – | 23226K | H2326 | SR230x5 | SNN526 | 230 | 150 | 380 | 190 | 445 | 130 | 50 | 288 |
| **125** | – | 22228K | H3128 | SR250x15 | SNN528 | 250 | 150 | 420 | 205 | 500 | 150 | 50 | 298 |
| | – | 23228K | H2328 | SR250x5 | SNN528 | 250 | 150 | 420 | 205 | 500 | 150 | 50 | 298 |
| **135** | – | 22230K | H3130 | SR270x16.5 | SNN530 | 270 | 160 | 450 | 220 | 530 | 160 | 60 | 322 |
| | – | 23230K | H2330 | SR270x5 | SNN530 | 270 | 160 | 450 | 220 | 530 | 160 | 60 | 322 |
| **140** | – | 22232K | H3132 | SR290x17 | SNN532 | 290 | 170 | 470 | 235 | 550 | 160 | 60 | 342 |
| | – | 23232K | H2332 | SR290x5 | SNN532 | 290 | 170 | 470 | 235 | 550 | 160 | 60 | 342 |

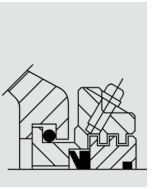




G Seals


C Seals

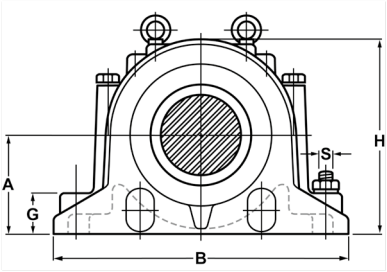

V Seals

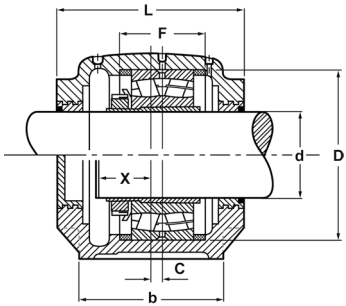

TS-U Seals

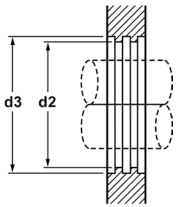

TACK Seals

| g (mm) | t (mm) | N (mm) | N1 (mm) | s (mm) | P | G Seals KIT | C Seals KIT | V Seals KIT (B1: Fitted Width) | TS-U Seals | TACK Seals | End Cover | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 58 | M16 | 28 | 22 | M20 | R1/4 | G516-KIT | C516-KIT | V516-KIT (9 ±1.2) | TS516U | TACK516 | 516A | 10.20 |
| 58 | M16 | 28 | 22 | M20 | R1/4 | G516-KIT | C516-KIT | V516-KIT (9 ±1.2) | TS516U | TACK516 | 516A | 10.20 |
| 68 | M16 | 28 | 22 | M20 | R1/4 | G616-KIT | C616-KIT | V616-KIT (9 ±1.2) | TS616U | TACK616 | 519A | 14.50 |
| 68 | M16 | 28 | 22 | M20 | R1/4 | G616-KIT | C616-KIT | V616-KIT (9 ±1.2) | TS616U | TACK616 | 519A | 14.50 |
| 61 | M16 | 28 | 22 | M20 | R1/4 | G517-KIT | C517-KIT | V517-KIT (9 ±1.2) | TS517U | TACK517 | 517A | 11.20 |
| 61 | M16 | 28 | 22 | M20 | R1/4 | G517-KIT | C517-KIT | V517-KIT (9 ±1.2) | TS517U | TACK517 | 517A | 11.20 |
| 70 | M20 | 32 | 26 | M24 | R1/4 | G617-KIT | C617-KIT | V617-KIT (9 ±1.2) | TS617U | TACK617 | 520A | 18.30 |
| 70 | M20 | 32 | 26 | M24 | R1/4 | G617-KIT | C617-KIT | V617-KIT (9 ±1.2) | TS617U | TACK617 | 520A | 18.30 |
| 65 | M16 | 28 | 22 | M20 | R1/4 | G518-KIT | C518-KIT | V518-KIT (9 ±1.2) | TS518U | TACK518 | 518A | 13.00 |
| 65 | M16 | 28 | 22 | M20 | R1/4 | G518-KIT | C518-KIT | V518-KIT (9 ±1.2) | TS518U | TACK518 | 518A | 13.00 |
| 65 | M16 | 28 | 22 | M20 | R1/4 | G518-KIT | C518-KIT | V518-KIT (9 ±1.2) | TS518U | TACK518 | 518A | 13.00 |
| 68 | M16 | 28 | 22 | M20 | R1/4 | G519-KIT | C519-KIT | V519-KIT (9 ±1.2) | TS519U | TACK519 | 519A | 14.50 |
| 68 | M16 | 28 | 22 | M20 | R1/4 | G519-KIT | C519-KIT | V519-KIT (9 ±1.2) | TS519U | TACK519 | 519A | 14.50 |
| 80 | M20 | 32 | 26 | M24 | R1/4 | G619-KIT | C619-KIT | V619-KIT (9 ±1.2) | TS619U | TACK619 | 522A | 24.00 |
| 80 | M20 | 32 | 26 | M24 | R1/4 | G619-KIT | C619-KIT | V619-KIT (9 ±1.2) | TS619U | TACK619 | 522A | 24.00 |
| 70 | M20 | 32 | 26 | M24 | R1/4 | G520-KIT | C520-KIT | V520-KIT (9 ±1.2) | TS520U | TACK520 | 520A | 18.30 |
| 70 | M20 | 32 | 26 | M24 | R1/4 | G520-KIT | C520-KIT | V520-KIT (9 ±1.2) | TS520U | TACK520 | 520A | 18.30 |
| 70 | M20 | 32 | 26 | M24 | R1/4 | G520-KIT | C520-KIT | V520-KIT (9 ±1.2) | TS520U | TACK520 | 520A | 18.30 |
| 86 | M20 | 32 | 26 | M24 | R3/8 | G620-KIT | C620-KIT | V620-KIT (9 ±1.2) | TS620U | TACK620 | 524A | 26.20 |
| 86 | M20 | 32 | 26 | M24 | R3/8 | G620-KIT | C620-KIT | V620-KIT (9 ±1.2) | TS620U | TACK620 | 524A | 26.20 |
| 80 | M20 | 32 | 26 | M24 | R1/4 | G522-KIT | C522-KIT | V522-KIT (9 ±1.2) | TS522U | TACK522 | 522A | 24.00 |
| 80 | M20 | 32 | 26 | M24 | R1/4 | G522-KIT | C522-KIT | V522-KIT (9 ±1.2) | TS522U | TACK522 | 522A | 24.00 |
| 80 | M20 | 32 | 26 | M24 | R1/4 | G522-KIT | C522-KIT | V522-KIT (9 ±1.2) | TS522U | TACK522 | 522A | 24.00 |
| 86 | M20 | 32 | 26 | M24 | R3/8 | G524-KIT | C524-KIT | V524-KIT (9 ±1.2) | TS524U | TACK524 | 524A | 26.20 |
| 86 | M20 | 32 | 26 | M24 | R3/8 | G524-KIT | C524-KIT | V524-KIT (9 ±1.2) | TS524U | TACK524 | 524A | 26.20 |
| 90 | M24 | 35 | 28 | M24 | R3/8 | G526-KIT | C526-KIT | V526-KIT (9 ±1.2) | TS526U | TACK526 | 526A | 33.00 |
| 90 | M24 | 35 | 28 | M24 | R3/8 | G526-KIT | C526-KIT | V526-KIT (9 ±1.2) | TS526U | TACK526 | 526A | 33.00 |
| 98 | M24 | 42 | 35 | M30 | R3/8 | G528-KIT | C528-KIT | V528-KIT (9 ±1.2) | TS528U | TACK528 | 528A | 40.00 |
| 98 | M24 | 42 | 35 | M30 | R3/8 | G528-KIT | C528-KIT | V528-KIT (9 ±1.2) | TS528U | TACK528 | 528A | 40.00 |
| 106 | M24 | 42 | 35 | M30 | R3/8 | G530-KIT | C530-KIT | V530-KIT (9 ±1.2) | TS530U | TACK530 | 530A | 49.00 |
| 106 | M24 | 42 | 35 | M30 | R3/8 | G530-KIT | C530-KIT | V530-KIT (9 ±1.2) | TS530U | TACK530 | 530A | 49.00 |
| 114 | M24 | 42 | 35 | M30 | R3/8 | G532-KIT | C532-KIT | V532-KIT (9 ±1.2) | TS532U | TACK532 | 532A | 55.00 |
| 114 | M24 | 42 | 35 | M30 | R3/8 | G532-KIT | C532-KIT | V532-KIT (9 ±1.2) | TS532U | TACK532 | 532A | 55.00 |

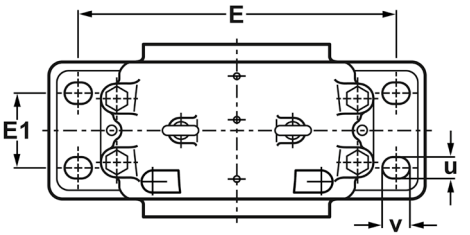
# Plummer Blocks SD 3100 Series

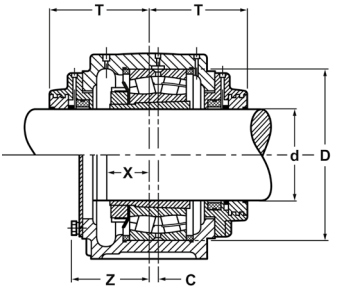



| Housing | Shaft Diameter (d) | | Dimensions mm | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Metric | Inch | D | d2 (H12) | d3 (H12) | A | B | F | E | b | G | H | L | C | E1 | X | T | Z | U | V |
| **SD3134** | 150 | 6 | 280 | 187 | 197 | 170 | 510 | 108 | 430 | 180 | 70 | 335 | 230 | 14 | 100 | 76 | 154 | 120 | 28 | 35 |
| **SD3136** | 160 | 6.1/2 | 300 | 195 | 205 | 180 | 530 | 116 | 450 | 190 | 75 | 355 | 240 | 15 | 110 | 81 | 159 | 130 | 30 | 38 |
| **SD3138** | 170 | 6.3/4 | 320 | 217 | 230 | 190 | 560 | 124 | 480 | 210 | 80 | 375 | 260 | 10 | 120 | 86 | 168 | 140 | 35 | 48 |
| **SD3140** | 180 | 7 | 340 | 222 | 237 | 210 | 610 | 132 | 510 | 230 | 85 | 410 | 280 | 10 | 130 | 91 | 178 | 150 | 35 | 42 |
| **SD3144** | 200 | 8 | 370 | 246 | 265 | 220 | 640 | 140 | 540 | 240 | 90 | 435 | 290 | 12 | 140 | 96 | 184 | 155 | 36 | 46 |
| **SD3148** | 220 | 9 | 400 | 265 | 285 | 240 | 700 | 148 | 600 | 260 | 95 | 475 | 310 | 12 | 150 | 102 | 194 | 160 | 38 | 46 |
| **SD3152** | 240 | 9.1/2 | 440 | 285 | 305 | 260 | 770 | 164 | 650 | 280 | 100 | 515 | 320 | 13 | 160 | 112 | 200 | 170 | 45 | 60 |
| **SD3156** | 260 | 10 | 460 | 307 | 327 | 280 | 790 | 166 | 670 | 280 | 105 | 550 | 330 | 16 | 160 | 115 | 200 | 170 | 45 | 60 |
| **SD3160** | 280 | 11 | 500 | 325 | 345 | 300 | 830 | 180 | 710 | 310 | 110 | 590 | 350 | 22 | 190 | 124 | 213 | 190 | 45 | 64 |
| **SD3164** | 300 | – | 540 | 345 | 365 | 320 | 880 | 196 | 750 | 330 | 115 | 630 | 370 | 23 | 200 | 135 | 224 | 200 | 45 | 72 |
| **SD3168** | 320 | – | 580 | 368 | 390 | 340 | 965 | 210 | 840 | 380 | 120 | 670 | 390 | 25 | 240 | 155 | 244 | 220 | 52 | 70 |
| **SD3172** | 340 | – | 600 | 388 | 408 | 360 | 1040 | 212 | 890 | 390 | 130 | 720 | 400 | 22 | 255 | 159 | 249 | 225 | 60 | 77 |
| **SD3176** | 360 | – | 620 | 408 | 428 | 380 | 1120 | 214 | 980 | 400 | 135 | 750 | 405 | 22 | 255 | 162 | 260 | 240 | 68 | 88 |
| **SD3180** | 380 | – | 650 | 428 | 448 | 400 | 1245 | 220 | 1050 | 420 | 140 | 790 | 425 | 22 | 270 | 167 | 276 | 260 | 75 | 96 |




| Bolt Diameter | Spherical Roller Bearing | Adapter Sleeve | | Weight | Locating Ring | Housing | Labyrinth Seal | End Cover |
|---|---|---|---|---|---|---|---|---|
| S | | Metric | Inch | kg | Dim. | | | |
| **M24** | 23134K | H3134 | HE3134 | 66 | 280x10 | SD3134 | TS34 | **TSA34** |
| **M24** | 23136K | H3136 | HE3136 | 75 | 300x10 | SD3136 | TS36 | **TSA36** |
| **M24** | 23138K | H3138 | HE3138 | 87 | 320x10 | SD3138 | TS38 | **TSA38** |
| **M30** | 23140K | H3140 | HE3140 | 113 | 340x10 | SD3140 | TS40 | **TSA40** |
| **M30** | 23144K | H3144 | – | 129 | 370x10 | SD3144 | TS44 | **TSA44** |
| **M30** | 23148K | H3148 | – | 163 | 400x10 | SD3148 | TS48 | **TSA48** |
| **M36** | 23152K | H3152 | – | 199 | 440x10 | SD3152 | TS52 | **TSA52** |
| **M36** | 23156K | H3156 | – | 226 | 460x10 | SD3156 | TS56 | **TSA56** |
| **M36** | 23160K | H3160 | – | 283 | 500x10 | SD3160 | TS60 | **TSA60** |
| **M36** | 23164K | H3164 | – | 346 | 540x10 | SD3164 | TS64 | **TSA64** |
| **M36** | 23168K | H3168 | – | 514 | 580x10 | SD3168 | TS68 | **TSA68** |
| **M48** | 23172K | H3172 | – | 594 | 600x10 | SD3172 | TS72 | **TSA72** |
| **M56** | 23176K | H3176 | – | 702 | 620x10 | SD3176 | TS76 | **TSA76** |
| **M64** | 23180K | H3180 | – | 740 | 650x10 | SD3180 | TS80 | **TSA80** |



## 13. ACCESSORIES FOR ROLLING BEARINGS

### ADAPTERS FOR ROLLING BEARINGS

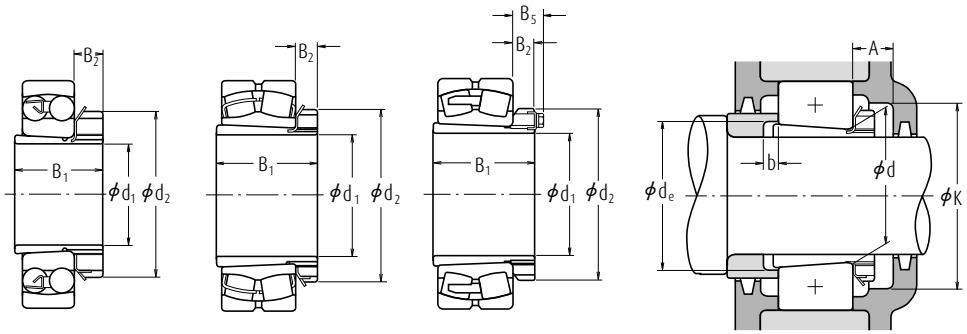

Shaft Dia. ..... Page
17 – 470 mm ..... B 376


### WITHDRAWAL SLEEVES FOR ROLLING BEARINGS


Shaft Dia. ..... Page
35 – 480 mm ..... B 384

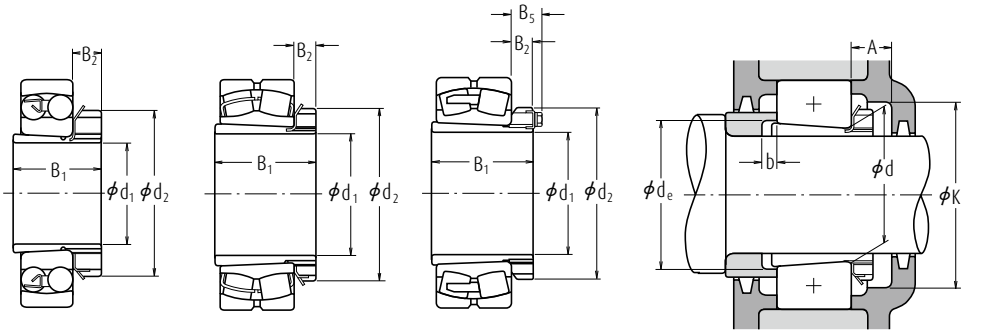
Nuts for Rolling Bearings ..... B 390
Stoppers for Nuts ..... B 395
Lock-Washers for Rolling Bearings ..... B 396

## Shaft Diameter 17 – 40 mm




| Shaft Diameter (mm) $d_1$ | Nominal Bearing Bore Dia. (mm) d | Nominal Numbers Applicable Bearings | | Dimensions (mm) $B_1$ | $d_2$ | $B_2$ | $B_5$ | Adapter Sleeve Numbers | Abutment Dimensions (mm) A min. | K min. | $d_e$ min. | b min. | Mass (kg) approx. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **17** | 20 | 1204K | **+ H204X** | 24 | 32 | 7 | – | A204X | 14 | 39 | 23 | 5 | 0.045 |
| | 20 | 2204K | **+ H304X** | 28 | 32 | 7 | – | A304X | 14 | 39 | 24 | 5 | 0.045 |
| | 20 | 1304K | **+ H304X** | 28 | 32 | 7 | – | A304X | 14 | 39 | 24 | 8 | 0.045 |
| | 20 | 2304K | **+ H2304X** | 31 | 32 | 7 | – | A2304X | 14 | 39 | 24 | 5 | 0.050 |
| **20** | 25 | 1205K | **+ H205X** | 26 | 38 | 8 | – | A205X | 15 | 45 | 28 | 5 | 0.065 |
| | 25 | 2205K | **+ H305X** | 29 | 38 | 8 | – | A305X | 15 | 45 | 29 | 5 | 0.075 |
| | 25 | 1305K | **+ H305X** | 29 | 38 | 8 | – | A305X | 15 | 45 | 29 | 6 | 0.075 |
| | 25 | 21305C DKE4 | **+ H305X** | 29 | 38 | 8 | – | A305X | 15 | 45 | 29 | 6 | 0.075 |
| | 25 | 2305K | **+ H2305X** | 35 | 38 | 8 | – | A2305X | 15 | 45 | 29 | 5 | 0.090 |
| **25** | 30 | 1206K | **+ H206X** | 27 | 45 | 8 | – | A206X | 15 | 50 | 33 | 5 | 0.10 |
| | 30 | 2206K | **+ H306X** | 31 | 45 | 8 | – | A306X | 15 | 50 | 34 | 5 | 0.11 |
| | 30 | 1306K | **+ H306X** | 31 | 45 | 8 | – | A306X | 15 | 50 | 34 | 6 | 0.11 |
| | 30 | 21306C DKE4 | **+ H306X** | 31 | 45 | 8 | – | A306X | 15 | 50 | 34 | 6 | 0.11 |
| | 30 | 2306K | **+ H2306X** | 38 | 45 | 8 | – | A2306X | 15 | 50 | 35 | 5 | 0.125 |
| **30** | 35 | 1207K | **+ H207X** | 29 | 52 | 9 | – | A207X | 17 | 58 | 38 | 5 | 0.125 |
| | 35 | 2207K | **+ H307X** | 35 | 52 | 9 | – | A307X | 17 | 58 | 39 | 5 | 0.145 |
| | 35 | 1307K | **+ H307X** | 35 | 52 | 9 | – | A307X | 17 | 58 | 39 | 7 | 0.145 |
| | 35 | 21307C DKE4 | **+ H307X** | 35 | 52 | 9 | – | A307X | 17 | 58 | 39 | 7 | 0.145 |
| | 35 | 2307K | **+ H2307X** | 43 | 52 | 9 | – | A2307X | 17 | 58 | 40 | 5 | 0.16 |
| **35** | 40 | 1208K | **+ H208X** | 31 | 58 | 10 | – | A208X | 17 | 65 | 44 | 5 | 0.175 |
| | 40 | 2208K | **+ H308X** | 36 | 58 | 10 | – | A308X | 17 | 65 | 44 | 5 | 0.19 |
| | 40 | 1308K | **+ H308X** | 36 | 58 | 10 | – | A308X | 17 | 65 | 44 | 5 | 0.19 |
| | 40 | 21308E AKE4 | **+ H308X** | 36 | 58 | 10 | – | A308X | 17 | 65 | 44 | 5 | 0.19 |
| | 40 | 2308K | **+ H2308X** | 46 | 58 | 10 | – | A2308X | 17 | 65 | 45 | 5 | 0.225 |
| | 40 | 22308E AKE4 | **+ H2308X** | 46 | 58 | 10 | – | A2308X | 17 | 65 | 45 | 5 | 0.225 |
| **40** | 45 | 1209K | **+ H209X** | 33 | 65 | 11 | – | A209X | 17 | 72 | 49 | 5 | 0.225 |
| | 45 | 2209K | **+ H309X** | 39 | 65 | 11 | – | A309X | 17 | 72 | 49 | 8 | 0.26 |
| | 45 | 1309K | **+ H309X** | 39 | 65 | 11 | – | A309X | 17 | 72 | 49 | 5 | 0.26 |
| | 45 | 21309E AKE4 | **+ H309X** | 39 | 65 | 11 | – | A309X | 17 | 72 | 49 | 5 | 0.26 |
| | 45 | 2309K | **+ H2309X** | 50 | 65 | 11 | – | A2309X | 17 | 72 | 50 | 5 | 0.30 |
| | 45 | 22309E AKE4 | **+ H2309X** | 50 | 65 | 11 | – | A2309X | 17 | 72 | 50 | 5 | 0.30 |

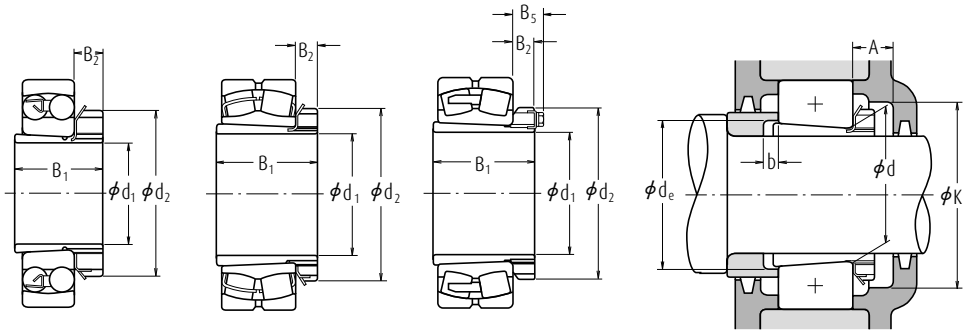
**Remark** The suffix X represents adapter sleeves having narrow slits, for which washers with straight tabs should be used.




| Shaft Diameter (mm) | Nominal Bearing Bore Dia. (mm) | Nominal Numbers | | Dimensions (mm) | | | | Adapter Sleeve Numbers | Abutment Dimensions (mm) | | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $d_1$ | d | Applicable Bearings | | $B_1$ | $d_2$ | $B_2$ | $B_5$ | | A min. | K min. | $d_e$ min. | b min. | approx. |
| **45** | 50 | 1210K | **+ H210X** | 35 | 70 | 12 | – | A210X | 19 | 76 | 53 | 5 | 0.275 |
| | 50 | 2210K | **+ H310X** | 42 | 70 | 12 | – | A310X | 19 | 76 | 54 | 10 | 0.30 |
| | 50 | 1310K | **+ H310X** | 42 | 70 | 12 | – | A310X | 19 | 76 | 54 | 5 | 0.30 |
| | 50 | 21310E AKE4 | **+ H310X** | 42 | 70 | 12 | – | A310X | 19 | 76 | 54 | 5 | 0.30 |
| | 50 | 2310K | **+ H2310X** | 55 | 70 | 12 | – | A2310X | 19 | 76 | 56 | 5 | 0.35 |
| | 50 | 22310E AKE4 | **+ H2310X** | 55 | 70 | 12 | – | A2310X | 19 | 76 | 56 | 5 | 0.35 |
| **50** | 55 | 1211K | **+ H211X** | 37 | 75 | 12 | – | A211X | 19 | 85 | 60 | 6 | 0.305 |
| | 55 | 2211K | **+ H311X** | 45 | 75 | 12 | – | A311X | 19 | 85 | 60 | 11 | 0.35 |
| | 55 | 22211E AKE4 | **+ H311X** | 45 | 75 | 12 | – | A311X | 19 | 85 | 60 | 11 | 0.35 |
| | 55 | 1311K | **+ H311X** | 45 | 75 | 12 | – | A311X | 19 | 85 | 60 | 6 | 0.35 |
| | 55 | 21311E AKE4 | **+ H311X** | 45 | 75 | 12 | – | A311X | 19 | 85 | 60 | 6 | 0.35 |
| | 55 | 2311K | **+ H2311X** | 59 | 75 | 12 | – | A2311X | 19 | 85 | 61 | 6 | 0.40 |
| | 55 | 22311E AKE4 | **+ H2311X** | 59 | 75 | 12 | – | A2311X | 19 | 85 | 61 | 6 | 0.40 |
| **55** | 60 | 1212K | **+ H212X** | 38 | 80 | 13 | – | A212X | 20 | 90 | 64 | 5 | 0.365 |
| | 60 | 2212K | **+ H312X** | 47 | 80 | 13 | – | A312X | 20 | 90 | 65 | 9 | 0.40 |
| | 60 | 22212E AKE4 | **+ H312X** | 47 | 80 | 13 | – | A312X | 20 | 90 | 65 | 9 | 0.40 |
| | 60 | 1312K | **+ H312X** | 47 | 80 | 13 | – | A312X | 20 | 90 | 65 | 5 | 0.40 |
| | 60 | 21312E AKE4 | **+ H312X** | 47 | 80 | 13 | – | A312X | 20 | 90 | 65 | 5 | 0.40 |
| | 60 | 2312K | **+ H2312X** | 62 | 80 | 13 | – | A2312X | 20 | 90 | 66 | 5 | 0.45 |
| | 60 | 22312E AKE4 | **+ H2312X** | 62 | 80 | 13 | – | A2312X | 20 | 90 | 66 | 5 | 0.45 |
| **60** | 65 | 1213K | **+ H213X** | 40 | 85 | 14 | – | A213X | 21 | 96 | 70 | 5 | 0.40 |
| | 65 | 2213K | **+ H313X** | 50 | 85 | 14 | – | A313X | 21 | 96 | 70 | 8 | 0.45 |
| | 65 | 22213E AKE4 | **+ H313X** | 50 | 85 | 14 | – | A313X | 21 | 96 | 70 | 8 | 0.45 |
| | 65 | 1313K | **+ H313X** | 50 | 85 | 14 | – | A313X | 21 | 96 | 70 | 5 | 0.45 |
| | 65 | 21313E AKE4 | **+ H313X** | 50 | 85 | 14 | – | A313X | 21 | 96 | 70 | 5 | 0.45 |
| | 65 | 2313K | **+ H2313X** | 65 | 85 | 14 | – | A2313X | 21 | 96 | 72 | 5 | 0.55 |
| | 65 | 22313E AKE4 | **+ H2313X** | 65 | 85 | 14 | – | A2313X | 21 | 96 | 72 | 5 | 0.55 |
| | 70 | 22214E AKE4 | **+ H314X** | 52 | 92 | 14 | – | A314X | 21 | 96 | 70 | 8 | 0.65 |
| | 70 | 21314E AKE4 | **+ H314X** | 52 | 92 | 14 | – | A314X | 21 | 96 | 70 | 5 | 0.65 |
| | 70 | 22314E AKE4 | **+ H2314X** | 68 | 92 | 14 | – | A2314X | 21 | 96 | 72 | 5 | 0.80 |

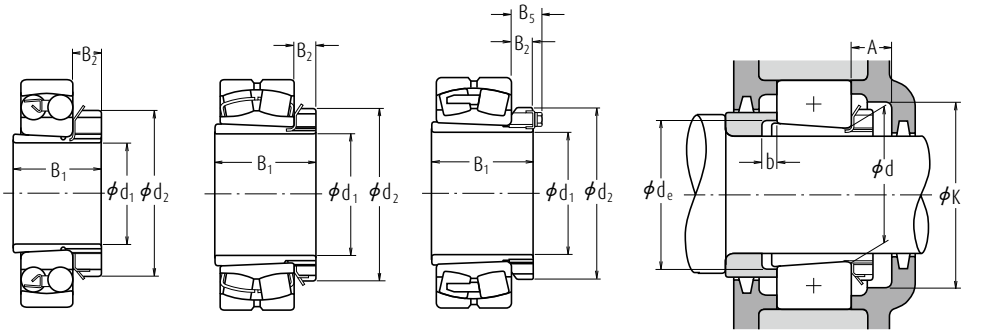
**Remark** The suffix X represents adapter sleeves having narrow slits, for which washers with straight tabs should be used.

## Shaft Diameter 65 – 80 mm




| Shaft Diameter (mm) $d_1$ | Nominal Bearing Bore Dia. (mm) d | Nominal Numbers Applicable Bearings | Dimensions (mm) $B_1$ | $d_2$ | $B_2$ | $B_5$ | Adapter Sleeve Numbers | Abutment Dimensions (mm) A min. | K min. | $d_e$ min. | b min. | Mass (kg) approx. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **65** | 75 | 1215K + **H215X** | 43 | 98 | 15 | – | A215X | 23 | 110 | 80 | 5 | 0.70 |
| | 75 | 2215K + **H315X** | 55 | 98 | 15 | – | A315X | 23 | 110 | 80 | 12 | 0.85 |
| | 75 | 22215E AKE4 + **H315X** | 55 | 98 | 15 | – | A315X | 23 | 110 | 80 | 12 | 0.85 |
| | 75 | 1315K + **H315X** | 55 | 98 | 15 | – | A315X | 23 | 110 | 80 | 5 | 0.85 |
| | 75 | 21315E AKE4 + **H315X** | 55 | 98 | 15 | – | A315X | 23 | 110 | 80 | 5 | 0.85 |
| | 75 | 2315K + **H2315X** | 73 | 98 | 15 | – | A2315X | 23 | 110 | 82 | 5 | 1.05 |
| | 75 | 22315E AKE4 + **H2315X** | 73 | 98 | 15 | – | A2315X | 23 | 110 | 82 | 5 | 1.05 |
| **70** | 80 | 1216K + **H216X** | 46 | 105 | 17 | – | A216X | 25 | 120 | 85 | 5 | 0.85 |
| | 80 | 2216K + **H316X** | 59 | 105 | 17 | – | A316X | 25 | 120 | 86 | 12 | 1.05 |
| | 80 | 22216E AKE4 + **H316X** | 59 | 105 | 17 | – | A316X | 25 | 120 | 86 | 12 | 1.05 |
| | 80 | 1316K + **H316X** | 59 | 105 | 17 | – | A316X | 25 | 120 | 86 | 5 | 1.05 |
| | 80 | 21316E AKE4 + **H316X** | 59 | 105 | 17 | – | A316X | 25 | 120 | 86 | 5 | 1.05 |
| | 80 | 2316K + **H2316X** | 78 | 105 | 17 | – | A2316X | 25 | 120 | 87 | 5 | 1.3 |
| | 80 | 22316E AKE4 + **H2316X** | 78 | 105 | 17 | – | A2316X | 25 | 120 | 87 | 5 | 1.3 |
| **75** | 85 | 1217K + **H217X** | 50 | 110 | 18 | – | A217X | 27 | 128 | 90 | 6 | 1.0 |
| | 85 | 2217K + **H317X** | 63 | 110 | 18 | – | A317X | 27 | 128 | 91 | 12 | 1.2 |
| | 85 | 22217E AKE4 + **H317X** | 63 | 110 | 18 | – | A317X | 27 | 128 | 91 | 12 | 1.2 |
| | 85 | 1317K + **H317X** | 63 | 110 | 18 | – | A317X | 27 | 128 | 91 | 6 | 1.2 |
| | 85 | 21317E AKE4 + **H317X** | 63 | 110 | 18 | – | A317X | 27 | 128 | 91 | 6 | 1.2 |
| | 85 | 2317K + **H2317X** | 82 | 110 | 18 | – | A2317X | 27 | 128 | 94 | 6 | 1.45 |
| | 85 | 22317E AKE4 + **H2317X** | 82 | 110 | 18 | – | A2317X | 27 | 128 | 94 | 6 | 1.45 |
| **80** | 90 | 1218K + **H218X** | 52 | 120 | 18 | – | A218X | 28 | 139 | 95 | 6 | 1.15 |
| | 90 | 2218K + **H318X** | 65 | 120 | 18 | – | A318X | 28 | 139 | 96 | 10 | 1.4 |
| | 90 | 22218E AKE4 + **H318X** | 65 | 120 | 18 | – | A318X | 28 | 139 | 96 | 10 | 1.4 |
| | 90 | 1318K + **H318X** | 65 | 120 | 18 | – | A318X | 28 | 139 | 96 | 6 | 1.4 |
| | 90 | 21318E AKE4 + **H318X** | 65 | 120 | 18 | – | A318X | 28 | 139 | 96 | 6 | 1.4 |
| | 90 | 2318K + **H2318X** | 86 | 120 | 18 | – | A2318X | 28 | 139 | 99 | 6 | 1.7 |
| | 90 | 23218C KE4 + **H2318X** | 86 | 120 | 18 | – | A2318X | 28 | 139 | 99 | 6 | 1.7 |
| | 90 | 22318E AKE4 + **H2318X** | 86 | 120 | 18 | – | A2318X | 28 | 139 | 99 | 6 | 1.7 |

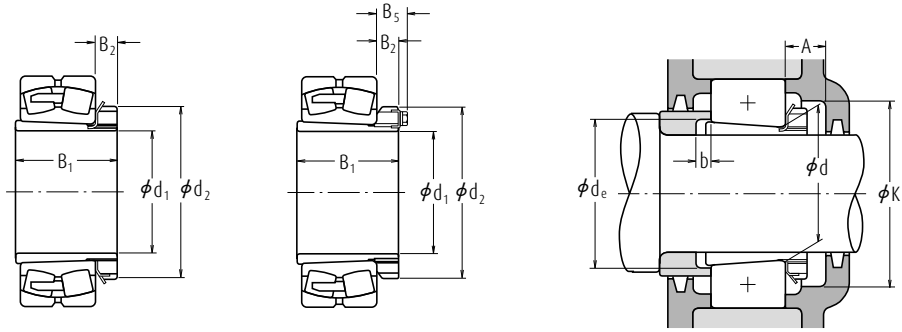
**Remark** The suffix X represents adapter sleeves having narrow slits, for which washers with straight tabs should be used.



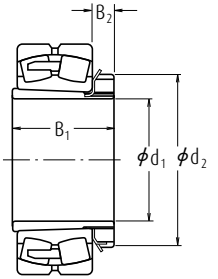

| Shaft Diameter (mm) | Nominal Bearing Bore Dia. (mm) | Nominal Numbers | | Dimensions (mm) | | | | Adapter Sleeve Numbers | Abutment Dimensions (mm) | | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $d_1$ | d | Applicable Bearings | | $B_1$ | $d_2$ | $B_2$ | $B_5$ | | A min. | K min. | $d_e$ min. | b min. | approx. |
| **85** | 95 | 1219K | **+ H219X** | 55 | 125 | 19 | – | A219X | 29 | 145 | 101 | 7 | 1.35 |
| | 95 | 2219K | **+ H319X** | 68 | 125 | 19 | – | A319X | 29 | 145 | 102 | 9 | 1.55 |
| | 95 | 22219E AKE4 | **+ H319X** | 68 | 125 | 19 | – | A319X | 29 | 145 | 102 | 9 | 1.55 |
| | 95 | 1319K | **+ H319X** | 68 | 125 | 19 | – | A319X | 29 | 145 | 102 | 7 | 1.55 |
| | 95 | 21319C KE4 | **+ H319X** | 68 | 125 | 19 | – | A319X | 29 | 145 | 102 | 7 | 1.55 |
| | 95 | 2319K | **+ H2319X** | 90 | 125 | 19 | – | A2319X | 29 | 145 | 105 | 7 | 1.9 |
| | 95 | 22319E AKE4 | **+ H2319X** | 90 | 125 | 19 | – | A2319X | 29 | 145 | 105 | 7 | 1.9 |
| **90** | 100 | 1220K | **+ H220X** | 58 | 130 | 20 | – | A220X | 30 | 150 | 106 | 7 | 1.45 |
| | 100 | 2220K | **+ H320X** | 71 | 130 | 20 | – | A320X | 30 | 150 | 107 | 8 | 1.7 |
| | 100 | 22220E AKE4 | **+ H320X** | 71 | 130 | 20 | – | A320X | 30 | 150 | 107 | 8 | 1.7 |
| | 100 | 1320K | **+ H320X** | 71 | 130 | 20 | – | A320X | 30 | 150 | 107 | 7 | 1.7 |
| | 100 | 21320C KE4 | **+ H320X** | 71 | 130 | 20 | – | A320X | 30 | 150 | 107 | 7 | 1.7 |
| | 100 | 2320K | **+ H2320X** | 97 | 130 | 20 | – | A2320X | 30 | 150 | 110 | 7 | 2.15 |
| | 100 | 23220C KE4 | **+ H2320X** | 97 | 130 | 20 | – | A2320X | 30 | 150 | 110 | 7 | 2.15 |
| | 100 | 22320E AKE4 | **+ H2320X** | 97 | 130 | 20 | – | A2320X | 30 | 150 | 110 | 7 | 2.15 |
| **100** | 110 | 23122C KE4 | **+ H3122X** | 81 | 145 | 21 | – | A3122X | 32 | 170 | 117 | 7 | 2.25 |
| | 110 | 1222K | **+ H222X** | 63 | 145 | 21 | – | A222X | 32 | 170 | 116 | 7 | 1.95 |
| | 110 | 2222K | **+ H322X** | 77 | 145 | 21 | – | A322X | 32 | 170 | 117 | 6 | 2.3 |
| | 110 | 22222E AKE4 | **+ H322X** | 77 | 145 | 21 | – | A322X | 32 | 170 | 117 | 6 | 2.3 |
| | 110 | 1322K | **+ H322X** | 77 | 145 | 21 | – | A322X | 32 | 170 | 117 | 9 | 2.3 |
| | 110 | 2322K | **+ H2322X** | 105 | 145 | 21 | – | A2322X | 32 | 170 | 121 | 7 | 2.75 |
| | 110 | 23222C KE4 | **+ H2322X** | 105 | 145 | 21 | – | A2322X | 32 | 170 | 121 | 17 | 2.75 |
| | 110 | 22322E AKE4 | **+ H2322X** | 105 | 145 | 21 | – | A2322X | 32 | 170 | 121 | 7 | 2.75 |
| **110** | 120 | 23024C DKE4 | **+ H3024** | 72 | 145 | 22 | – | A3024 | 33 | 180 | 127 | 7 | 1.95 |
| | 120 | 23124C KE4 | **+ H3124** | 88 | 155 | 22 | – | A3124 | 33 | 180 | 128 | 7 | 2.65 |
| | 120 | 22224E AKE4 | **+ H3124** | 88 | 155 | 22 | – | A3124 | 33 | 180 | 128 | 11 | 2.65 |
| | 120 | 23224C KE4 | **+ H2324** | 112 | 155 | 22 | – | A2324 | 33 | 180 | 131 | 17 | 3.2 |
| | 120 | 22324E AKE4 | **+ H2324** | 112 | 155 | 22 | – | A2324 | 33 | 180 | 131 | 7 | 3.2 |
| **115** | 130 | 23026C DKE4 | **+ H3026** | 80 | 155 | 23 | – | A3026 | 34 | 190 | 137 | 8 | 2.85 |
| | 130 | 23126C KE4 | **+ H3126** | 92 | 165 | 23 | – | A3126 | 34 | 190 | 138 | 8 | 3.65 |
| | 130 | 22226E AKE4 | **+ H3126** | 92 | 165 | 23 | – | A3126 | 34 | 190 | 138 | 8 | 3.65 |
| | 130 | 23226C KE4 | **+ H2326** | 121 | 165 | 23 | – | A2326 | 34 | 190 | 142 | 21 | 4.6 |
| | 130 | 22326C KE4 | **+ H2326** | 121 | 165 | 23 | – | A2326 | 34 | 190 | 142 | 8 | 4.6 |

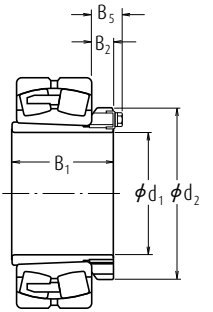
**Remark** The suffix X represents adapter sleeves having narrow slits, for which washers with straight tabs should be used.

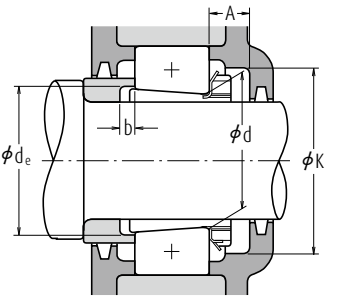
## Shaft Diameter 125 – 170 mm




| Shaft Diameter (mm) $d_1$ | Nominal Bearing Bore Dia. (mm) d | Nominal Numbers Applicable Bearings | Dimensions (mm) $B_1$ | $d_2$ | $B_2$ | $B_5$ | Adapter Sleeve Numbers | Abutment Dimensions (mm) A min. | K min. | $d_e$ min. | b min. | Mass (kg) approx. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **125** | 140 | 23028C DKE4 + **H3028** | 82 | 165 | 24 | – | A3028 | 36 | 205 | 147 | 8 | 3.15 |
| | 140 | 23128C KE4 + **H3128** | 97 | 180 | 24 | – | A3128 | 36 | 205 | 149 | 8 | 4.35 |
| | 140 | 22228C DKE4 + **H3128** | 97 | 180 | 24 | – | A3128 | 36 | 205 | 149 | 8 | 4.35 |
| | 140 | 23228C KE4 + **H2328** | 131 | 180 | 24 | – | A2328 | 36 | 205 | 152 | 22 | 5.55 |
| | 140 | 22328C KE4 + **H2328** | 131 | 180 | 24 | – | A2328 | 36 | 205 | 152 | 8 | 5.55 |
| **135** | 150 | 23030C DKE4 + **H3030** | 87 | 180 | 26 | – | A3030 | 37 | 220 | 158 | 8 | 3.9 |
| | 150 | 23130C KE4 + **H3130** | 111 | 195 | 26 | – | A3130 | 37 | 220 | 160 | 8 | 5.5 |
| | 150 | 22230C DKE4 + **H3130** | 111 | 195 | 26 | – | A3130 | 37 | 220 | 160 | 15 | 5.5 |
| | 150 | 23230C KE4 + **H2330** | 139 | 195 | 26 | – | A2330 | 37 | 220 | 163 | 20 | 6.6 |
| | 150 | 22330C AKE4 + **H2330** | 139 | 195 | 26 | – | A2330 | 37 | 220 | 163 | 8 | 6.6 |
| **140** | 160 | 23932C AKE4 + **H3932** | 78 | 190 | 28 | – | A3932 | 39 | 205 | 168 | 8 | 4.64 |
| | 160 | 23032C DKE4 + **H3032** | 93 | 190 | 28 | – | A3032 | 39 | 230 | 168 | 8 | 5.2 |
| | 160 | 23132C KE4 + **H3132** | 119 | 210 | 28 | – | A3132 | 39 | 230 | 170 | 8 | 7.65 |
| | 160 | 22232C DKE4 + **H3132** | 119 | 210 | 28 | – | A3132 | 39 | 230 | 170 | 14 | 7.65 |
| | 160 | 23232C KE4 + **H2332** | 147 | 210 | 28 | – | A2332 | 39 | 230 | 174 | 18 | 9.15 |
| | 160 | 22332C AKE4 + **H2332** | 147 | 210 | 28 | – | A2332 | 39 | 230 | 174 | 8 | 9.15 |
| **150** | 170 | 23934B CAKE4 + **H3934** | 79 | 200 | 29 | – | A3934 | 40 | 215 | 179 | 8 | 5.07 |
| | 170 | 23034C DKE4 + **H3034** | 101 | 200 | 29 | – | A3034 | 40 | 250 | 179 | 8 | 6.0 |
| | 170 | 23134C KE4 + **H3134** | 122 | 220 | 29 | – | A3134 | 40 | 250 | 180 | 8 | 8.4 |
| | 170 | 22234C DKE4 + **H3134** | 122 | 220 | 29 | – | A3134 | 40 | 250 | 180 | 10 | 8.4 |
| | 170 | 23234C KE4 + **H2334** | 154 | 220 | 29 | – | A2334 | 40 | 250 | 185 | 18 | 10 |
| | 170 | 22334C AKE4 + **H2334** | 154 | 220 | 29 | – | A2334 | 40 | 250 | 185 | 8 | 10 |
| **160** | 180 | 23936C AKE4 + **H3936** | 87 | 210 | 30 | – | A3936 | 41 | 230 | 189 | 8 | 5.87 |
| | 180 | 23036C DKE4 + **H3036** | 109 | 210 | 30 | – | A3036 | 41 | 260 | 189 | 8 | 6.85 |
| | 180 | 23136C KE4 + **H3136** | 131 | 230 | 30 | – | A3136 | 41 | 260 | 191 | 8 | 9.5 |
| | 180 | 22236C DKE4 + **H3136** | 131 | 230 | 30 | – | A3136 | 41 | 260 | 191 | 18 | 9.5 |
| | 180 | 23236C KE4 + **H2336** | 161 | 230 | 30 | – | A2336 | 41 | 260 | 195 | 22 | 11.5 |
| | 180 | 22336C AKE4 + **H2336** | 161 | 230 | 30 | – | A2336 | 41 | 260 | 195 | 8 | 11.5 |
| **170** | 190 | 23938C AKE4 + **H3938** | 89 | 220 | 31 | – | A3938 | 43 | 240 | 199 | 9 | 6.35 |
| | 190 | 23038C AKE4 + **H3038** | 112 | 220 | 31 | – | A3038 | 43 | 270 | 199 | 9 | 7.45 |
| | 190 | 23138C KE4 + **H3138** | 141 | 240 | 31 | – | A3138 | 43 | 270 | 202 | 9 | 11 |
| | 190 | 22238C AKE4 + **H3138** | 141 | 240 | 31 | – | A3138 | 43 | 270 | 202 | 21 | 11 |
| | 190 | 23238C KE4 + **H2338** | 169 | 240 | 31 | – | A2338 | 43 | 270 | 206 | 21 | 12.5 |
| | 190 | 22338C AKE4 + **H2338** | 169 | 240 | 31 | – | A2338 | 43 | 270 | 206 | 9 | 12.5 |

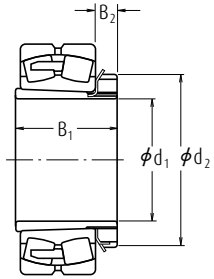


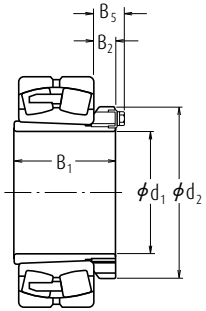



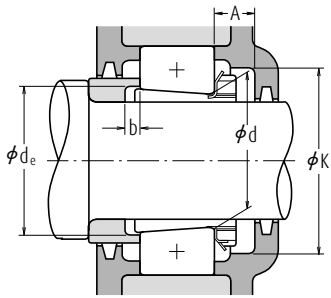




| Shaft Diameter (mm) | Nominal Bearing Bore Dia. (mm) | Nominal Numbers | | Dimensions (mm) | | | | Adapter Sleeve Numbers | Abutment Dimensions (mm) | | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $d_1$ | d | Applicable Bearings | | $B_1$ | $d_2$ | $B_2$ | $B_5$ | | A min. | K min. | $d_e$ min. | b min. | approx. |
| **180** | 200 | 23940C AKE4 | **+ H3940** | 98 | 240 | 32 | – | A3940 | 46 | 260 | 210 | 10 | 8.0 |
| | 200 | 23040C AKE4 | **+ H3040** | 120 | 240 | 32 | – | A3040 | 46 | 280 | 210 | 10 | 9.2 |
| | 200 | 23140C KE4 | **+ H3140** | 150 | 250 | 32 | – | A3140 | 46 | 280 | 212 | 10 | 12 |
| | 200 | 22240C AKE4 | **+ H3140** | 150 | 250 | 32 | – | A3140 | 46 | 280 | 212 | 24 | 12 |
| | 200 | 23240C KE4 | **+ H2340** | 176 | 250 | 32 | – | A2340 | 46 | 280 | 216 | 20 | 14 |
| | 200 | 22340C AKE4 | **+ H2340** | 176 | 250 | 32 | – | A2340 | 46 | 280 | 216 | 10 | 14 |
| **200** | 220 | 23944C AKE4 | **+ H3944** | 96 | 260 | 30 | 41 | A3944 | 55 | 280 | 231 | 10 | 8.32 |
| | 220 | 23044C AKE4 | **+ H3044** | 128 | 260 | 30 | 41 | A3044 | 55 | 320 | 231 | 12 | 10.5 |
| | 220 | 23144C KE4 | **+ H3144** | 158 | 280 | 32 | 44 | A3144 | 55 | 320 | 233 | 10 | 14.5 |
| | 220 | 22244C AKE4 | **+ H3144** | 158 | 280 | 32 | 44 | A3144 | 55 | 320 | 233 | 22 | 14.5 |
| | 220 | 23244C KE4 | **+ H2344** | 183 | 280 | 32 | 44 | A2344 | 55 | 320 | 236 | 11 | 16.5 |
| | 220 | 22344C AKE4 | **+ H2344** | 183 | 280 | 32 | 44 | A2344 | 55 | 320 | 236 | 10 | 16.5 |
| **220** | 240 | 23948C AKE4 | **+ H3948** | 101 | 290 | 34 | 46 | A3948 | 60 | 300 | 251 | 11 | 11.2 |
| | 240 | 23048C AKE4 | **+ H3048** | 133 | 290 | 34 | 46 | A3048 | 60 | 340 | 251 | 11 | 13 |
| | 240 | 23148C KE4 | **+ H3148** | 169 | 300 | 34 | 46 | A3148 | 60 | 340 | 254 | 11 | 17.5 |
| | 240 | 22248C AKE4 | **+ H3148** | 169 | 300 | 34 | 46 | A3148 | 60 | 340 | 254 | 19 | 17.5 |
| | 240 | 23248C AKE4 | **+ H2348** | 196 | 300 | 34 | 46 | A2348 | 60 | 340 | 257 | 6 | 19.5 |
| | 240 | 22348C AKE4 | **+ H2348** | 196 | 300 | 34 | 46 | A2348 | 60 | 340 | 257 | 11 | 19.5 |
| **240** | 260 | 23952C AKE4 | **+ H3952** | 116 | 310 | 34 | 46 | A3952 | 60 | 330 | 272 | 11 | 13.4 |
| | 260 | 23052C AKE4 | **+ H3052** | 147 | 310 | 34 | 46 | A3052 | 60 | 370 | 272 | 13 | 15.5 |
| | 260 | 23152C AKE4 | **+ H3152** | 187 | 330 | 36 | 49 | A3152 | 60 | 370 | 276 | 11 | 22 |
| | 260 | 22252C AKE4 | **+ H3152** | 187 | 330 | 36 | 49 | A3152 | 60 | 370 | 276 | 25 | 22 |
| | 260 | 23252C AKE4 | **+ H2352** | 208 | 330 | 36 | 49 | A2352 | 60 | 370 | 278 | 2 | 24 |
| | 260 | 22352C AKE4 | **+ H2352** | 208 | 330 | 36 | 49 | A2352 | 60 | 370 | 278 | 11 | 24 |
| **260** | 280 | 23956C AKE4 | **+ H3956** | 121 | 330 | 38 | 50 | A3956 | 65 | 350 | 292 | 12 | 15.5 |
| | 280 | 23056C AKE4 | **+ H3056** | 152 | 330 | 38 | 50 | A3056 | 65 | 390 | 292 | 12 | 17.5 |
| | 280 | 23156C AKE4 | **+ H3156** | 192 | 350 | 38 | 51 | A3156 | 65 | 390 | 296 | 12 | 24.5 |
| | 280 | 22256C AKE4 | **+ H3156** | 192 | 350 | 38 | 51 | A3156 | 65 | 390 | 296 | 28 | 24.5 |
| | 280 | 23256C AKE4 | **+ H2356** | 221 | 350 | 38 | 51 | A2356 | 65 | 390 | 299 | 11 | 28 |
| | 280 | 22356C AKE4 | **+ H2356** | 221 | 350 | 38 | 51 | A2356 | 65 | 390 | 299 | 12 | 28 |

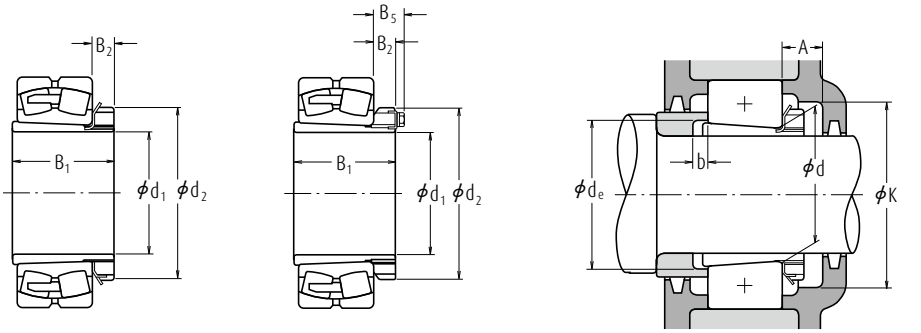
## Shaft Diameter 280 – 410 mm



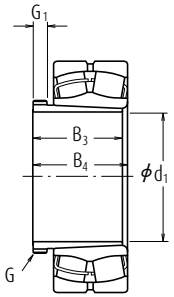




| Shaft Diameter (mm) | Nominal Bearing Bore Dia. (mm) | Nominal Numbers | Dimensions (mm) | | | | Adapter Sleeve Numbers | Abutment Dimensions (mm) | | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $d_1$ | d | Applicable Bearings | $B_1$ | $d_2$ | $B_2$ | $B_5$ | | A min. | K min. | $d_e$ min. | b min. | approx. |
| **280** | 300 | 23960C AKE4 + **H3960** | 140 | 360 | 42 | 54 | A3960 | 69 | 380 | 313 | 12 | 20.7 |
| | 300 | 23060C AKE4 + **H3060** | 168 | 360 | 42 | 54 | A3060 | 69 | 430 | 313 | 12 | 23 |
| | 300 | 23160C AKE4 + **H3160** | 208 | 380 | 40 | 53 | A3160 | 69 | 430 | 317 | 12 | 30 |
| | 300 | 22260C AKE4 + **H3160** | 208 | 380 | 40 | 53 | A3160 | 69 | 430 | 317 | 32 | 30 |
| | 300 | 23260C AKE4 + **H3260** | 240 | 380 | 40 | 53 | A3260 | 69 | 430 | 321 | 12 | 34 |
| **300** | 320 | 23964C AKE4 + **H3964** | 140 | 380 | 42 | 55 | A3964 | 72 | 400 | 334 | 13 | 21.8 |
| | 320 | 23064C AKE4 + **H3064** | 171 | 380 | 42 | 55 | A3064 | 72 | 450 | 334 | 13 | 24.5 |
| | 320 | 23164C AKE4 + **H3164** | 226 | 400 | 42 | 56 | A3164 | 72 | 450 | 339 | 13 | 35 |
| | 320 | 22264C AKE4 + **H3164** | 226 | 400 | 42 | 56 | A3164 | 72 | 450 | 339 | 39 | 35 |
| | 320 | 23264C AKE4 + **H3264** | 258 | 400 | 42 | 56 | A3264 | 72 | 450 | 343 | 13 | 39.5 |
| **320** | 340 | 23968C AKE4 + **H3968** | 144 | 400 | 45 | 58 | A3968 | 75 | 430 | 354 | 14 | 24.6 |
| | 340 | 23068C AKE4 + **H3068** | 187 | 400 | 45 | 58 | A3068 | 75 | 490 | 355 | 14 | 28.5 |
| | 340 | 23168C AKE4 + **H3168** | 254 | 440 | 55 | 72 | A3168 | 75 | 490 | 360 | 14 | 49.5 |
| | 340 | 23268C AKE4 + **H3268** | 288 | 440 | 55 | 72 | A3268 | 75 | 490 | 364 | 14 | 54.5 |
| **340** | 360 | 23972C AKE4 + **H3972** | 144 | 420 | 45 | 58 | A3972 | 75 | 450 | 374 | 14 | 25.7 |
| | 360 | 23072C AKE4 + **H3072** | 188 | 420 | 45 | 58 | A3072 | 75 | 510 | 375 | 14 | 30.5 |
| | 360 | 23172C AKE4 + **H3172** | 259 | 460 | 58 | 75 | A3172 | 75 | 510 | 380 | 14 | 54 |
| | 360 | 23272C AKE4 + **H3272** | 299 | 460 | 58 | 75 | A3272 | 75 | 510 | 385 | 14 | 60.5 |
| **360** | 380 | 23976C AKE4 + **H3976** | 164 | 450 | 48 | 62 | A3976 | 82 | 480 | 396 | 15 | 31.9 |
| | 380 | 23076C AKE4 + **H3076** | 193 | 450 | 48 | 62 | A3076 | 82 | 540 | 396 | 15 | 36 |
| | 380 | 23176C AKE4 + **H3176** | 264 | 490 | 60 | 77 | A3176 | 82 | 540 | 401 | 15 | 61.5 |
| | 380 | 23276C AKE4 + **H3276** | 310 | 490 | 60 | 77 | A3276 | 82 | 540 | 405 | 15 | 69.5 |
| **380** | 400 | 23980C AKE4 + **H3980** | 168 | 470 | 52 | 66 | A3980 | 86 | 500 | 417 | 15 | 35.2 |
| | 400 | 23080C AKE4 + **H3080** | 210 | 470 | 52 | 66 | A3080 | 86 | 580 | 417 | 15 | 41.5 |
| | 400 | 23180C AKE4 + **H3180** | 272 | 520 | 62 | 82 | A3180 | 86 | 580 | 421 | 15 | 70.5 |
| | 400 | 23280C AKE4 + **H3280** | 328 | 520 | 62 | 82 | A3280 | 86 | 580 | 427 | 15 | 81 |
| **400** | 420 | 23984C AKE4 + **H3984** | 168 | 490 | 52 | 66 | A3984 | 86 | 520 | 437 | 16 | 36.6 |
| | 420 | 23084C AKE4 + **H3084** | 212 | 490 | 52 | 66 | A3084 | 86 | 600 | 437 | 16 | 43.5 |
| | 420 | 23184C AKE4 + **H3184** | 304 | 540 | 70 | 90 | A3184 | 86 | 600 | 443 | 16 | 84 |
| | 420 | 23284C AKE4 + **H3284** | 352 | 540 | 70 | 90 | A3284 | 86 | 600 | 448 | 16 | 94 |
| **410** | 440 | 23988C AKE4 + **H3988** | 189 | 520 | 60 | 77 | A3988 | 99 | 550 | 458 | 17 | 58.6 |
| | 440 | 23088C AKE4 + **H3088** | 228 | 520 | 60 | 77 | A3088 | 99 | 620 | 458 | 17 | 65 |
| | 440 | 23188C AKE4 + **H3188** | 307 | 560 | 70 | 90 | A3188 | 99 | 620 | 464 | 17 | 104 |
| | 440 | 23288C AKE4 + **H3288** | 361 | 560 | 70 | 90 | A3288 | 99 | 620 | 469 | 17 | 118 |

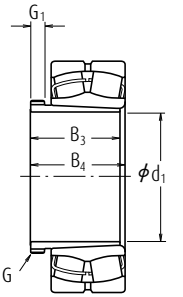



| Shaft Diameter (mm) $d_1$ | Nominal Bearing Bore Dia. (mm) d | Nominal Numbers Applicable Bearings | | Dimensions (mm) $B_1$ | $d_2$ | $B_2$ | $B_5$ | Adapter Sleeve Numbers | Abutment Dimensions (mm) A min. | K min. | $d_e$ min. | b min. | Mass (kg) approx. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **430** | 460 | 23992C AKE4 | **+ H3992** | 189 | 540 | 60 | 77 | A3992 | 99 | 570 | 478 | 17 | 62 |
| | 460 | 23092C AKE4 | **+ H3092** | 234 | 540 | 60 | 77 | A3092 | 99 | 650 | 478 | 17 | 69.5 |
| | 460 | 23192C AKE4 | **+ H3192** | 326 | 580 | 75 | 95 | A3192 | 99 | 650 | 485 | 17 | 116 |
| | 460 | 23292C AKE4 | **+ H3292** | 382 | 580 | 75 | 95 | A3292 | 99 | 650 | 491 | 17 | 132 |
| **450** | 480 | 23996C AKE4 | **+ H3996** | 200 | 560 | 60 | 77 | A3996 | 99 | 600 | 499 | 18 | 67.5 |
| | 480 | 23096C AKE4 | **+ H3096** | 237 | 560 | 60 | 77 | A3096 | 99 | 690 | 499 | 18 | 73.5 |
| | 480 | 23196C AKE4 | **+ H3196** | 335 | 620 | 75 | 95 | A3196 | 99 | 690 | 505 | 18 | 133 |
| | 480 | 23296C AKE4 | **+ H3296** | 397 | 620 | 75 | 95 | A3296 | 99 | 690 | 512 | 18 | 152 |
| **470** | 500 | 239/500C AKE4 | **+ H39/500** | 208 | 580 | 68 | 85 | A39/500 | 109 | 620 | 519 | 18 | 74.6 |
| | 500 | 230/500C AKE4 | **+ H30/500** | 247 | 580 | 68 | 85 | A30/500 | 109 | 700 | 519 | 18 | 82 |
| | 500 | 231/500C AKE4 | **+ H31/500** | 356 | 630 | 80 | 100 | A31/500 | 109 | 700 | 527 | 18 | 143 |
| | 500 | 232/500C AKE4 | **+ H32/500** | 428 | 630 | 80 | 100 | A32/500 | 109 | 700 | 534 | 18 | 166 |

## Shaft Diameter 35 – 85 mm

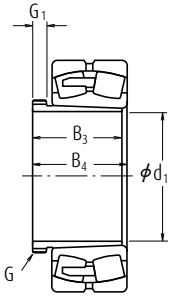



| Shaft Diameter (mm) | Nominal Bearing Bore Dia. (mm) | Nominal Numbers | | Screw Thread | Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|
| $d_1$ | d | Applicable Bearings | | G | $B_3$ | $G_1$ | $B_4$ | approx. |
| **35** | 40 | 21308EAKE4 | + **AH308** | M 45 × 1.5 | 29 | 6 | 32 | 0.09 |
| | 40 | 22308EAKE4 | + **AH2308** | M 45 × 1.5 | 40 | 7 | 43 | 0.13 |
| **40** | 45 | 21309EAKE4 | + **AH309** | M 50 × 1.5 | 31 | 6 | 34 | 0.11 |
| | 45 | 22309EAKE4 | + **AH2309** | M 50 × 1.5 | 44 | 7 | 47 | 0.165 |
| **45** | 50 | 21310EAKE4 | + **AHX310** | M 55 × 2 | 35 | 7 | 38 | 0.16 |
| | 50 | 22310EAKE4 | + **AHX2310** | M 55 × 2 | 50 | 9 | 53 | 0.235 |
| **50** | 55 | 22211EAKE4 | + **AHX311** | M 60 × 2 | 37 | 7 | 40 | 0.19 |
| | 55 | 21311EAKE4 | + **AHX311** | M 60 × 2 | 37 | 7 | 40 | 0.19 |
| | 55 | 22311EAKE4 | + **AHX2311** | M 60 × 2 | 54 | 10 | 57 | 0.285 |
| **55** | 60 | 22212EAKE4 | + **AHX312** | M 65 × 2 | 40 | 8 | 43 | 0.215 |
| | 60 | 21312EAKE4 | + **AHX312** | M 65 × 2 | 40 | 8 | 43 | 0.215 |
| | 60 | 22312EAKE4 | + **AHX2312** | M 65 × 2 | 58 | 11 | 61 | 0.34 |
| **60** | 65 | 22213EAKE4 | + **AH313** | M 75 × 2 | 42 | 8 | 45 | 0.255 |
| | 65 | 21313EAKE4 | + **AH313** | M 75 × 2 | 42 | 8 | 45 | 0.255 |
| | 65 | 22313EAKE4 | + **AH2313** | M 75 × 2 | 61 | 12 | 64 | 0.395 |
| **65** | 70 | 22214EAKE4 | + **AH314** | M 80 × 2 | 43 | 8 | 47 | 0.28 |
| | 70 | 21314EAKE4 | + **AH314** | M 80 × 2 | 43 | 8 | 47 | 0.28 |
| | 70 | 22314EAKE4 | + **AHX2314** | M 80 × 2 | 64 | 12 | 68 | 0.53 |
| **70** | 75 | 22215EAKE4 | + **AH315** | M 85 × 2 | 45 | 8 | 49 | 0.315 |
| | 75 | 21315EAKE4 | + **AH315** | M 85 × 2 | 45 | 8 | 49 | 0.315 |
| | 75 | 22315EAKE4 | + **AHX2315** | M 85 × 2 | 68 | 12 | 72 | 0.605 |
| **75** | 80 | 22216EAKE4 | + **AH316** | M 90 × 2 | 48 | 8 | 52 | 0.365 |
| | 80 | 21316EAKE4 | + **AH316** | M 90 × 2 | 48 | 8 | 52 | 0.365 |
| | 80 | 22316EAKE4 | + **AHX2316** | M 90 × 2 | 71 | 12 | 75 | 0.665 |
| **80** | 85 | 22217EAKE4 | + **AHX317** | M 95 × 2 | 52 | 9 | 56 | 0.48 |
| | 85 | 21317EAKE4 | + **AHX317** | M 95 × 2 | 52 | 9 | 56 | 0.48 |
| | 85 | 22317EAKE4 | + **AHX2317** | M 95 × 2 | 74 | 13 | 78 | 0.745 |
| **85** | 90 | 22218EAKE4 | + **AHX318** | M 100 × 2 | 53 | 9 | 57 | 0.52 |
| | 90 | 21318EAKE4 | + **AHX318** | M 100 × 2 | 53 | 9 | 57 | 0.52 |
| | 90 | 23218CKE4 | + **AHX3218** | M 100 × 2 | 63 | 10 | 67 | 0.58 |
| | 90 | 22318EAKE4 | + **AHX2318** | M 100 × 2 | 79 | 14 | 83 | 0.845 |

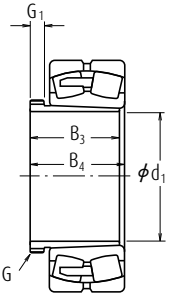



| Shaft Diameter (mm) | Nominal Bearing Bore Dia. (mm) | Nominal Numbers | | Screw Thread | Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|
| $d_1$ | d | Applicable Bearings | | G | $B_3$ | $G_1$ | $B_4$ | approx. |
| **90** | 95 | 22219EAKE4 | + **AHX319** | M 105 × 2 | 57 | 10 | 61 | 0.595 |
| | 95 | 21319CKE4 | + **AHX319** | M 105 × 2 | 57 | 10 | 61 | 0.595 |
| | 95 | 22319EAKE4 | + **AHX2319** | M 105 × 2 | 85 | 16 | 89 | 0.89 |
| **95** | 100 | 21320CKE4 | + **AHX3120** | M 110 × 2 | 64 | 11 | 68 | 0.70 |
| | 100 | 22220EAKE4 | + **AHX320** | M 110 × 2 | 59 | 10 | 63 | 0.66 |
| | 100 | 21320CKE4 | + **AHX320** | M 110 × 2 | 59 | 10 | 63 | 0.66 |
| | 100 | 23220CKE4 | + **AHX3220** | M 110 × 2 | 73 | 11 | 77 | 0.77 |
| | 100 | 22320EAKE4 | + **AHX2320** | M 110 × 2 | 90 | 16 | 94 | 1.0 |
| **105** | 110 | 23122CKE4 | + **AHX3122** | M 120 × 2 | 68 | 11 | 72 | 0.76 |
| | 110 | 22222EAKE4 | + **AHX3122** | M 120 × 2 | 68 | 11 | 72 | 0.76 |
| | 110 | 24122CK30E4 | + **AH24122** | M 115 × 2 | 82 | 13 | 91 | 0.73 |
| | 110 | 23222CKE4 | + **AHX3222** | M 125 × 2 | 82 | 11 | 86 | 1.04 |
| | 110 | 22322EAKE4 | + **AHX2322** | M 125 × 2 | 98 | 16 | 102 | 1.35 |
| **115** | 120 | 23024CDKE4 | + **AHX3024** | M 130 × 2 | 60 | 13 | 64 | 0.75 |
| | 120 | 24024CK30E4 | + **AH24024** | M 125 × 2 | 73 | 13 | 82 | 0.70 |
| | 120 | 23124CKE4 | + **AHX3124** | M 130 × 2 | 75 | 12 | 79 | 0.95 |
| | 120 | 22224EAKE4 | + **AHX3124** | M 130 × 2 | 75 | 12 | 79 | 0.95 |
| | 120 | 24124CK30E4 | + **AH24124** | M 130 × 2 | 93 | 13 | 102 | 1.02 |
| | 120 | 23224CKE4 | + **AHX3224** | M 135 × 2 | 90 | 13 | 94 | 1.3 |
| | 120 | 22324EAKE4 | + **AHX2324** | M 135 × 2 | 105 | 17 | 109 | 1.6 |
| **125** | 130 | 23026CDKE4 | + **AHX3026** | M 140 × 2 | 67 | 14 | 71 | 0.95 |
| | 130 | 24026CK30E4 | + **AH24026** | M 135 × 2 | 83 | 14 | 93 | 0.89 |
| | 130 | 23126CKE4 | + **AHX3126** | M 140 × 2 | 78 | 12 | 82 | 1.08 |
| | 130 | 22226EAKE4 | + **AHX3126** | M 140 × 2 | 78 | 12 | 82 | 1.08 |
| | 130 | 24126CK30E4 | + **AH24126** | M 140 × 2 | 94 | 14 | 104 | 1.14 |
| | 130 | 23226CKE4 | + **AHX3226** | M 145 × 2 | 98 | 15 | 102 | 1.58 |
| | 130 | 22326CKE4 | + **AHX2326** | M 145 × 2 | 115 | 19 | 119 | 1.97 |
| **135** | 140 | 23028CDKE4 | + **AHX3028** | M 150 × 2 | 68 | 14 | 73 | 1.01 |
| | 140 | 24028CK30E4 | + **AH24028** | M 145 × 2 | 83 | 14 | 93 | 0.96 |
| | 140 | 23128CKE4 | + **AHX3128** | M 150 × 2 | 83 | 14 | 88 | 1.28 |
| | 140 | 22228CDKE4 | + **AHX3128** | M 150 × 2 | 83 | 14 | 88 | 1.28 |
| | 140 | 24128CK30E4 | + **AH24128** | M 150 × 2 | 99 | 14 | 109 | 1.3 |
| | 140 | 23228CKE4 | + **AHX3228** | M 155 × 3 | 104 | 15 | 109 | 1.84 |
| | 140 | 22328CKE4 | + **AHX2328** | M 155 × 3 | 125 | 20 | 130 | 2.33 |

## Shaft Diameter 145 – 180 mm

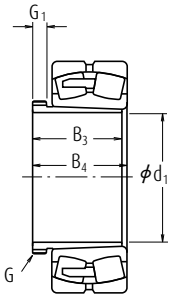



| Shaft Diameter (mm) | Nominal Bearing Bore Dia. (mm) | Nominal Numbers | Screw Thread | Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|---|---|---|---|
| $d_1$ | d | Applicable Bearings | G | $B_3$ | $G_1$ | $B_4$ | approx. |
| **145** | 150 | 23030CDKE4 + **AHX3030** | M 160 × 3 | 72 | 15 | 77 | 1.15 |
| | 150 | 24030CK30E4 + **AH24030** | M 155 × 3 | 90 | 15 | 101 | 1.11 |
| | 150 | 23130CKE4 + **AHX3130** | M 165 × 3 | 96 | 15 | 101 | 1.79 |
| | 150 | 22230CDKE4 + **AHX3130** | M 165 × 3 | 96 | 15 | 101 | 1.79 |
| | 150 | 24130CK30E4 + **AH24130** | M 160 × 3 | 115 | 15 | 126 | 1.63 |
| | 150 | 23230CKE4 + **AHX3230** | M 165 × 3 | 114 | 17 | 119 | 2.22 |
| | 150 | 22330CAKE4 + **AHX2330** | M 165 × 3 | 135 | 24 | 140 | 2.82 |
| **150** | 160 | 23032CDKE4 + **AH3032** | M 170 × 3 | 77 | 16 | 82 | 2.05 |
| | 160 | 24032CK30E4 + **AH24032** | M 170 × 3 | 95 | 15 | 106 | 2.28 |
| | 160 | 23132CKE4 + **AH3132** | M 180 × 3 | 103 | 16 | 108 | 3.2 |
| | 160 | 22232CDKE4 + **AH3132** | M 180 × 3 | 103 | 16 | 108 | 3.2 |
| | 160 | 24132CK30E4 + **AH24132** | M 170 × 3 | 124 | 15 | 135 | 3.03 |
| | 160 | 23232CKE4 + **AH3232** | M 180 × 3 | 124 | 20 | 130 | 4.1 |
| | 160 | 22332CAKE4 + **AH2332** | M 180 × 3 | 140 | 24 | 146 | 4.7 |
| **160** | 170 | 23034CDKE4 + **AH3034** | M 180 × 3 | 85 | 17 | 90 | 2.45 |
| | 170 | 24034CK30E4 + **AH24034** | M 180 × 3 | 106 | 16 | 117 | 2.74 |
| | 170 | 23134CKE4 + **AH3134** | M 190 × 3 | 104 | 16 | 109 | 3.4 |
| | 170 | 22234CDKE4 + **AH3134** | M 190 × 3 | 104 | 16 | 109 | 3.4 |
| | 170 | 24134CK30E4 + **AH24134** | M 180 × 3 | 125 | 16 | 136 | 3.26 |
| | 170 | 23234CKE4 + **AH3234** | M 190 × 3 | 134 | 24 | 140 | 4.8 |
| | 170 | 22334CAKE4 + **AH2334** | M 190 × 3 | 146 | 24 | 152 | 5.25 |
| **170** | 180 | 23036CDKE4 + **AH3036** | M 190 × 3 | 92 | 17 | 98 | 2.8 |
| | 180 | 24036CK30E4 + **AH24036** | M 190 × 3 | 116 | 16 | 127 | 3.19 |
| | 180 | 23136CKE4 + **AH3136** | M 200 × 3 | 116 | 19 | 122 | 4.2 |
| | 180 | 24136CK30E4 + **AH24136** | M 190 × 3 | 134 | 16 | 145 | 3.74 |
| | 180 | 22236CDKE4 + **AH2236** | M 200 × 3 | 105 | 17 | 110 | 3.75 |
| | 180 | 23236CKE4 + **AH3236** | M 200 × 3 | 140 | 24 | 146 | 5.3 |
| | 180 | 22336CAKE4 + **AH2336** | M 200 × 3 | 154 | 26 | 160 | 5.85 |
| **180** | 190 | 23038CAKE4 + **AH3038** | Tr 205 × 4 | 96 | 18 | 102 | 3.35 |
| | 190 | 24038CK30E4 + **AH24038** | M 200 × 3 | 118 | 18 | 131 | 3.47 |
| | 190 | 23138CKE4 + **AH3138** | Tr 210 × 4 | 125 | 20 | 131 | 4.9 |
| | 190 | 24138CK30E4 + **AH24138** | M 200 × 3 | 146 | 18 | 159 | 4.38 |
| | 190 | 22238CAKE4 + **AH2238** | Tr 210 × 4 | 112 | 18 | 117 | 4.25 |
| | 190 | 23238CKE4 + **AH3238** | Tr 210 × 4 | 145 | 25 | 152 | 5.9 |
| | 190 | 22338CAKE4 + **AH2338** | Tr 210 × 4 | 160 | 26 | 167 | 6.65 |

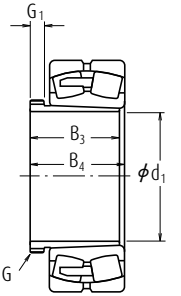



| Shaft Diameter (mm) | Nominal Bearing Bore Dia. (mm) | Nominal Numbers | | Screw Thread | Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|
| $d_1$ | d | Applicable Bearings | | G | $B_3$ | $G_1$ | $B_4$ | approx. |
| **190** | 200 | 23040CAKE4 | + **AH3040** | Tr 215 × 4 | 102 | 19 | 108 | 3.8 |
| | 200 | 24040CK30E4 | + **AH24040** | Tr 210 × 4 | 127 | 18 | 140 | 3.92 |
| | 200 | 23140CKE4 | + **AH3140** | Tr 220 × 4 | 134 | 21 | 140 | 5.5 |
| | 200 | 24140CK30E4 | + **AH24140** | Tr 210 × 4 | 158 | 18 | 171 | 5.0 |
| | 200 | 22240CAKE4 | + **AH2240** | Tr 220 × 4 | 118 | 19 | 123 | 4.7 |
| | 200 | 23240CKE4 | + **AH3240** | Tr 220 × 4 | 153 | 25 | 160 | 6.7 |
| | 200 | 22340CAKE4 | + **AH2340** | Tr 220 × 4 | 170 | 30 | 177 | 7.55 |
| **200** | 220 | 23044CAKE4 | + **AH3044** | Tr 235 × 4 | 111 | 20 | 117 | 7.4 |
| | 220 | 24044CK30E4 | + **AH24044** | Tr 230 × 4 | 138 | 20 | 152 | 8.23 |
| | 220 | 23144CKE4 | + **AH3144** | Tr 240 × 4 | 145 | 23 | 151 | 10.5 |
| | 220 | 24144CK30E4 | + **AH24144** | Tr 230 × 4 | 170 | 20 | 184 | 10.3 |
| | 220 | 22244CAKE4 | + **AH2244** | Tr 240 × 4 | 130 | 20 | 136 | 9.1 |
| | 220 | 23244CKE4 | + **AH2344** | Tr 240 × 4 | 181 | 30 | 189 | 13.5 |
| | 220 | 22344CAKE4 | + **AH2344** | Tr 240 × 4 | 181 | 30 | 189 | 13.5 |
| **220** | 240 | 23048CAKE4 | + **AH3048** | Tr 260 × 4 | 116 | 21 | 123 | 8.75 |
| | 240 | 24048CK30E4 | + **AH24048** | Tr 250 × 4 | 138 | 20 | 153 | 9.0 |
| | 240 | 23148CKE4 | + **AH3148** | Tr 260 × 4 | 154 | 25 | 161 | 12 |
| | 240 | 24148CK30E4 | + **AH24148** | Tr 260 × 4 | 180 | 20 | 195 | 12.6 |
| | 240 | 22248CAKE4 | + **AH2248** | Tr 260 × 4 | 144 | 21 | 150 | 11 |
| | 240 | 23248CAKE4 | + **AH2348** | Tr 260 × 4 | 189 | 30 | 197 | 15.5 |
| | 240 | 22348CAKE4 | + **AH2348** | Tr 260 × 4 | 189 | 30 | 197 | 15.5 |
| **240** | 260 | 23052CAKE4 | + **AH3052** | Tr 280 × 4 | 128 | 23 | 135 | 10.5 |
| | 260 | 24052CAK30E4 | + **AH24052** | Tr 270 × 4 | 162 | 22 | 178 | 11.7 |
| | 260 | 23152CAKE4 | + **AH3152** | Tr 290 × 4 | 172 | 26 | 179 | 16 |
| | 260 | 24152CAK30E4 | + **AH24152** | Tr 280 × 4 | 202 | 22 | 218 | 15.5 |
| | 260 | 22252CAKE4 | + **AH2252** | Tr 290 × 4 | 155 | 23 | 161 | 14 |
| | 260 | 23252CAKE4 | + **AH2352** | Tr 290 × 4 | 205 | 30 | 213 | 19.5 |
| | 260 | 22352CAKE4 | + **AH2352** | Tr 290 × 4 | 205 | 30 | 213 | 19.5 |
| **260** | 280 | 23056CAKE4 | + **AH3056** | Tr 300 × 4 | 131 | 24 | 139 | 12 |
| | 280 | 24056CAK30E4 | + **AH24056** | Tr 290 × 4 | 162 | 22 | 179 | 12.6 |
| | 280 | 23156CAKE4 | + **AH3156** | Tr 310 × 5 | 175 | 28 | 183 | 17.5 |
| | 280 | 24156CAK30E4 | + **AH24156** | Tr 300 × 4 | 202 | 22 | 219 | 16.8 |
| | 280 | 22256CAKE4 | + **AH2256** | Tr 310 × 5 | 155 | 24 | 163 | 15 |
| | 280 | 23256CAKE4 | + **AH2356** | Tr 310 × 5 | 212 | 30 | 220 | 21.5 |
| | 280 | 22356CAKE4 | + **AH2356** | Tr 310 × 5 | 212 | 30 | 220 | 21.5 |

## Shaft Diameter 280 – 380 mm

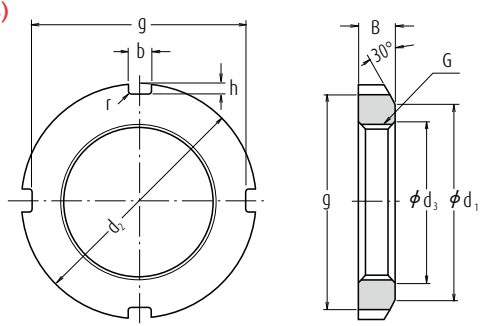



| Shaft Diameter (mm) | Nominal Bearing Bore Dia. (mm) | Nominal Numbers | | Screw Thread | Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|
| $d_1$ | d | Applicable Bearings | | G | $B_3$ | $G_1$ | $B_4$ | approx. |
| **280** | 300 | 23060CAKE4 | + **AH3060** | Tr 320 × 5 | 145 | 26 | 153 | 14.5 |
| | 300 | 24060CAK30E4 | + **AH24060** | Tr 310 × 5 | 184 | 24 | 202 | 15.5 |
| | 300 | 23160CAKE4 | + **AH3160** | Tr 330 × 5 | 192 | 30 | 200 | 21 |
| | 300 | 24160CAK30E4 | + **AH24160** | Tr 320 × 5 | 224 | 24 | 242 | 20.3 |
| | 300 | 22260CAKE4 | + **AH2260** | Tr 330 × 5 | 170 | 26 | 178 | 18 |
| | 300 | 23260CAKE4 | + **AH3260** | Tr 330 × 5 | 228 | 34 | 236 | 20 |
| **300** | 320 | 23064CAKE4 | + **AH3064** | Tr 345 × 5 | 149 | 27 | 157 | 16 |
| | 320 | 24064CAK30E4 | + **AH24064** | Tr 330 × 5 | 184 | 24 | 202 | 16.4 |
| | 320 | 23164CAKE4 | + **AH3164** | Tr 350 × 5 | 209 | 31 | 217 | 24.5 |
| | 320 | 24164CAK30E4 | + **AH24164** | Tr 340 × 5 | 242 | 24 | 260 | 23.5 |
| | 320 | 23264CAKE4 | + **AH3264** | Tr 350 × 5 | 246 | 36 | 254 | 25 |
| **320** | 340 | 23068CAKE4 | + **AH3068** | Tr 365 × 5 | 162 | 28 | 171 | 19.5 |
| | 340 | 24068CAK30E4 | + **AH24068** | Tr 360 × 5 | 206 | 26 | 225 | 21.2 |
| | 340 | 23168CAKE4 | + **AH3168** | Tr 370 × 5 | 225 | 33 | 234 | 29 |
| | 340 | 24168CAK30E4 | + **AH24168** | Tr 360 × 5 | 269 | 26 | 288 | 28.3 |
| | 340 | 23268CAKE4 | + **AH3268** | Tr 370 × 5 | 264 | 38 | 273 | 35.5 |
| **340** | 360 | 23072CAKE4 | + **AH3072** | Tr 385 × 5 | 167 | 30 | 176 | 21 |
| | 360 | 24072CAK30E4 | + **AH24072** | Tr 380 × 5 | 206 | 26 | 226 | 22.5 |
| | 360 | 23172CAKE4 | + **AH3172** | Tr 400 × 5 | 229 | 35 | 238 | 33 |
| | 360 | 24172CAK30E4 | + **AH24172** | Tr 380 × 5 | 269 | 26 | 289 | 30 |
| | 360 | 23272CAKE4 | + **AH3272** | Tr 400 × 5 | 274 | 40 | 283 | 41.5 |
| **360** | 380 | 23076CAKE4 | + **AH3076** | Tr 410 × 5 | 170 | 31 | 180 | 23.5 |
| | 380 | 24076CAK30E4 | + **AH24076** | Tr 400 × 5 | 208 | 28 | 228 | 24.1 |
| | 380 | 23176CAKE4 | + **AH3176** | Tr 420 × 5 | 232 | 36 | 242 | 35.5 |
| | 380 | 24176CAK30E4 | + **AH24176** | Tr 400 × 5 | 271 | 28 | 291 | 32.1 |
| | 380 | 23276CAKE4 | + **AH3276** | Tr 420 × 5 | 284 | 42 | 294 | 45.5 |
| **380** | 400 | 23080CAKE4 | + **AH3080** | Tr 430 × 5 | 183 | 33 | 193 | 27.5 |
| | 400 | 24080CAK30E4 | + **AH24080** | Tr 420 × 5 | 228 | 28 | 248 | 28 |
| | 400 | 23180CAKE4 | + **AH3180** | Tr 440 × 5 | 240 | 38 | 250 | 39.5 |
| | 400 | 24180CAK30E4 | + **AH24180** | Tr 420 × 5 | 278 | 28 | 298 | 34.8 |
| | 400 | 23280CAKE4 | + **AH3280** | Tr 440 × 5 | 302 | 44 | 312 | 51.5 |




| Shaft Diameter (mm) | Nominal Bearing Bore Dia. (mm) | Nominal Numbers | | Screw Thread | Dimensions (mm) | | | Mass (kg) |
|---|---|---|---|---|---|---|---|---|
| $d_1$ | d | Applicable Bearings | | G | $B_3$ | $G_1$ | $B_4$ | approx. |
| **400** | 420 | 23084CAKE4 | + **AH3084** | Tr 450 × 5 | 186 | 34 | 196 | 29 |
| | 420 | 24084CAK30E4 | + **AH24084** | Tr 440 × 5 | 230 | 30 | 252 | 29.8 |
| | 420 | 23184CAKE4 | + **AH3184** | Tr 460 × 5 | 266 | 40 | 276 | 46.5 |
| | 420 | 24184CAK30E4 | + **AH24184** | Tr 440 × 5 | 310 | 30 | 332 | 41.4 |
| | 420 | 23284CAKE4 | + **AH3284** | Tr 460 × 5 | 321 | 46 | 331 | 59 |
| **420** | 440 | 23088CAKE4 | + **AHX3088** | Tr 470 × 5 | 194 | 35 | 205 | 42 |
| | 440 | 24088CAK30E4 | + **AH24088** | Tr 460 × 5 | 242 | 30 | 264 | 33 |
| | 440 | 23188CAKE4 | + **AHX3188** | Tr 480 × 5 | 270 | 42 | 281 | 50 |
| | 440 | 24188CAK30E4 | + **AH24188** | Tr 460 × 5 | 310 | 30 | 332 | 43.5 |
| | 440 | 23288CAKE4 | + **AHX3288** | Tr 480 × 5 | 330 | 48 | 341 | 64 |
| **440** | 460 | 23092CAKE4 | + **AHX3092** | Tr 490 × 5 | 202 | 37 | 213 | 46 |
| | 460 | 24092CAK30E4 | + **AH24092** | Tr 480 × 5 | 250 | 32 | 273 | 35.9 |
| | 460 | 23192CAKE4 | + **AHX3192** | Tr 510 × 6 | 285 | 43 | 296 | 58 |
| | 460 | 24192CAK30E4 | + **AH24192** | Tr 480 × 5 | 332 | 32 | 355 | 49.7 |
| | 460 | 23292CAKE4 | + **AHX3292** | Tr 510 × 6 | 349 | 50 | 360 | 74.5 |
| **460** | 480 | 23096CAKE4 | + **AHX3096** | Tr 520 × 6 | 205 | 38 | 217 | 51 |
| | 480 | 24096CAK30E4 | + **AH24096** | Tr 500 × 5 | 250 | 32 | 273 | 37.5 |
| | 480 | 23196CAKE4 | + **AHX3196** | Tr 530 × 6 | 295 | 45 | 307 | 63 |
| | 480 | 24196CAK30E4 | + **AH24196** | Tr 500 × 5 | 340 | 32 | 363 | 53 |
| | 480 | 23296CAKE4 | + **AHX3296** | Tr 530 × 6 | 364 | 52 | 376 | 82 |
| **480** | 500 | 230/500CAKE4 | + **AHX30/500** | Tr 540 × 6 | 209 | 40 | 221 | 54.5 |
| | 500 | 240/500CAK30E4 | + **AH240/500** | Tr 530 × 6 | 253 | 35 | 276 | 41.9 |
| | 500 | 231/500CAKE4 | + **AHX31/500** | Tr 550 × 6 | 313 | 47 | 325 | 71 |
| | 500 | 241/500CAK30E4 | + **AH241/500** | Tr 530 × 6 | 360 | 35 | 383 | 61.2 |
| | 500 | 232/500CAKE4 | + **AHX32/500** | Tr 550 × 6 | 393 | 54 | 405 | 94.5 |

## (For Adapters and Shafts)



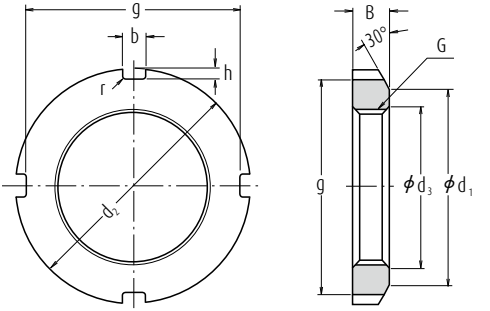

Nut with Washer

Units : mm

| Nominal Numbers | Nut Series AN | | | | | | | | | | Reference | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Screw Threads | Basic Dimensions | | | | | | | | Mass (kg) | Adapter (1) Sleeve Bore Dia. Numbers | Washer Numbers | Shaft Dia. |
| | G | $d_2$ | $d_1$ | g | b | h | $d_3$ | B | r max. | approx. | | | |
| **AN 02** | M 15×1 | 25 | 21 | 21 | 4 | 2 | 15.5 | 5 | 0.4 | 0.010 | — | **AW 02 X** | 15 |
| **AN 03** | M 17×1 | 28 | 24 | 24 | 4 | 2 | 17.5 | 5 | 0.4 | 0.013 | — | **AW 03 X** | 17 |
| **AN 04** | M 20×1 | 32 | 26 | 28 | 4 | 2 | 20.5 | 6 | 0.4 | 0.019 | 04 | **AW 04 X** | 20 |
| **AN 05** | M 25×1.5 | 38 | 32 | 34 | 5 | 2 | 25.8 | 7 | 0.4 | 0.025 | 05 | **AW 05 X** | 25 |
| **AN 06** | M 30×1.5 | 45 | 38 | 41 | 5 | 2 | 30.8 | 7 | 0.4 | 0.043 | 06 | **AW 06 X** | 30 |
| **AN 07** | M 35×1.5 | 52 | 44 | 48 | 5 | 2 | 35.8 | 8 | 0.4 | 0.053 | 07 | **AW 07 X** | 35 |
| **AN 08** | M 40×1.5 | 58 | 50 | 53 | 6 | 2.5 | 40.8 | 9 | 0.5 | 0.085 | 08 | **AW 08 X** | 40 |
| **AN 09** | M 45×1.5 | 65 | 56 | 60 | 6 | 2.5 | 45.8 | 10 | 0.5 | 0.119 | 09 | **AW 09 X** | 45 |
| **AN 10** | M 50×1.5 | 70 | 61 | 65 | 6 | 2.5 | 50.8 | 11 | 0.5 | 0.148 | 10 | **AW 10 X** | 50 |
| **AN 11** | M 55×2 | 75 | 67 | 69 | 7 | 3 | 56 | 11 | 0.5 | 0.158 | 11 | **AW 11 X** | 55 |
| **AN 12** | M 60×2 | 80 | 73 | 74 | 7 | 3 | 61 | 11 | 0.5 | 0.174 | 12 | **AW 12 X** | 60 |
| **AN 13** | M 65×2 | 85 | 79 | 79 | 7 | 3 | 66 | 12 | 0.5 | 0.203 | 13 | **AW 13 X** | 65 |
| **AN 14** | M 70×2 | 92 | 85 | 85 | 8 | 3.5 | 71 | 12 | 0.5 | 0.242 | 14 | **AW 14 X** | 70 |
| **AN 15** | M 75×2 | 98 | 90 | 91 | 8 | 3.5 | 76 | 13 | 0.5 | 0.287 | 15 | **AW 15 X** | 75 |
| **AN 16** | M 80×2 | 105 | 95 | 98 | 8 | 3.5 | 81 | 15 | 0.6 | 0.395 | 16 | **AW 16 X** | 80 |
| **AN 17** | M 85×2 | 110 | 102 | 103 | 8 | 3.5 | 86 | 16 | 0.6 | 0.45 | 17 | **AW 17 X** | 85 |
| **AN 18** | M 90×2 | 120 | 108 | 112 | 10 | 4 | 91 | 16 | 0.6 | 0.555 | 18 | **AW 18 X** | 90 |
| **AN 19** | M 95×2 | 125 | 113 | 117 | 10 | 4 | 96 | 17 | 0.6 | 0.66 | 19 | **AW 19 X** | 95 |
| **AN 20** | M 100×2 | 130 | 120 | 122 | 10 | 4 | 101 | 18 | 0.6 | 0.70 | 20 | **AW 20 X** | 100 |
| **AN 21** | M 105×2 | 140 | 126 | 130 | 12 | 5 | 106 | 18 | 0.7 | 0.845 | 21 | **AW 21 X** | 105 |
| **AN 22** | M 110×2 | 145 | 133 | 135 | 12 | 5 | 111 | 19 | 0.7 | 0.965 | 22 | **AW 22 X** | 110 |
| **AN 23** | M 115×2 | 150 | 137 | 140 | 12 | 5 | 116 | 19 | 0.7 | 1.01 | — | **AW 23** | 115 |
| **AN 24** | M 120×2 | 155 | 138 | 145 | 12 | 5 | 121 | 20 | 0.7 | 1.08 | 24 | **AW 24** | 120 |
| **AN 25** | M 125×2 | 160 | 148 | 150 | 12 | 5 | 126 | 21 | 0.7 | 1.19 | — | **AW 25** | 125 |

**Note** (1) Applicable to adapter sleeve Series A31, A2, A3, and A23.

**Remark** The basic design and dimensions of screw threads are in accordance with JIS B 0205.




Nut with Washer

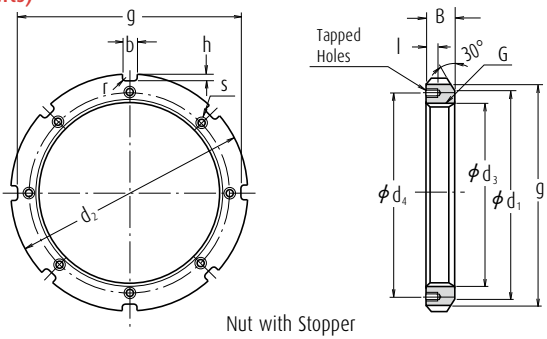
Units : mm

| Nominal Numbers | Nut Series AN | | | | | | | | | | Reference | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Screw Threads | Basic Dimensions | | | | | | | | Mass (kg) | Adapter (1) Sleeve Bore Dia. Numbers | Washer Numbers | Shaft Dia. |
| | G | $d_2$ | $d_1$ | g | b | h | $d_3$ | B | r max. | approx. | | | |
| **AN 26** | M 130×2 | 165 | 149 | 155 | 12 | 5 | 131 | 21 | 0.7 | 1.25 | 26 | **AW 26** | 130 |
| **AN 27** | M 135×2 | 175 | 160 | 163 | 14 | 6 | 136 | 22 | 0.7 | 1.55 | — | **AW 27** | 135 |
| **AN 28** | M 140×2 | 180 | 160 | 168 | 14 | 6 | 141 | 22 | 0.7 | 1.56 | 28 | **AW 28** | 140 |
| **AN 29** | M 145×2 | 190 | 172 | 178 | 14 | 6 | 146 | 24 | 0.7 | 2.0 | — | **AW 29** | 145 |
| **AN 30** | M 150×2 | 195 | 171 | 183 | 14 | 6 | 151 | 24 | 0.7 | 2.03 | 30 | **AW 30** | 150 |
| **AN 31** | M 155×3 | 200 | 182 | 186 | 16 | 7 | 156.5 | 25 | 0.7 | 2.21 | — | — | — |
| **AN 32** | M 160×3 | 210 | 182 | 196 | 16 | 7 | 161.5 | 25 | 0.7 | 2.59 | 32 | **AW 32** | 160 |
| **AN 33** | M 165×3 | 210 | 193 | 196 | 16 | 7 | 166.5 | 26 | 0.7 | 2.43 | — | — | — |
| **AN 34** | M 170×3 | 220 | 193 | 206 | 16 | 7 | 171.5 | 26 | 0.7 | 2.8 | 34 | **AW 34** | 170 |
| **AN 36** | M 180×3 | 230 | 203 | 214 | 18 | 8 | 181.5 | 27 | 0.7 | 3.05 | 36 | **AW 36** | 180 |
| **AN 38** | M 190×3 | 240 | 214 | 224 | 18 | 8 | 191.5 | 28 | 0.7 | 3.4 | 38 | **AW 38** | 190 |
| **AN 40** | M 200×3 | 250 | 226 | 234 | 18 | 8 | 201.5 | 29 | 0.7 | 3.7 | 40 | **AW 40** | 200 |
| **Nut Series ANL** | | | | | | | | | | | | | |
| **ANL 24** | M 120×2 | 145 | 133 | 135 | 12 | 5 | 121 | 20 | 0.7 | 0.78 | 24 | **AWL 24** | 120 |
| **ANL 26** | M 130×2 | 155 | 143 | 145 | 12 | 5 | 131 | 21 | 0.7 | 0.88 | 26 | **AWL 26** | 130 |
| **ANL 28** | M 140×2 | 165 | 151 | 153 | 14 | 6 | 141 | 22 | 0.7 | 0.99 | 28 | **AWL 28** | 140 |
| **ANL 30** | M 150×2 | 180 | 164 | 168 | 14 | 6 | 151 | 24 | 0.7 | 1.38 | 30 | **AWL 30** | 150 |
| **ANL 32** | M 160×3 | 190 | 174 | 176 | 16 | 7 | 161.5 | 25 | 0.7 | 1.56 | 32 | **AWL 32** | 160 |
| **ANL 34** | M 170×3 | 200 | 184 | 186 | 16 | 7 | 171.5 | 26 | 0.7 | 1.72 | 34 | **AWL 34** | 170 |
| **ANL 36** | M 180×3 | 210 | 192 | 194 | 18 | 8 | 181.5 | 27 | 0.7 | 1.95 | 36 | **AWL 36** | 180 |
| **ANL 38** | M 190×3 | 220 | 202 | 204 | 18 | 8 | 191.5 | 28 | 0.7 | 2.08 | 38 | **AWL 38** | 190 |
| **ANL 40** | M 200×3 | 240 | 218 | 224 | 18 | 8 | 201.5 | 29 | 0.7 | 2.98 | 40 | **AWL 40** | 200 |

**Note** (1) Series AN is applicable to adapter sleeve Series A31 and A23.
Series ANL is applicable to adapter sleeve Series A30.

**Remark** The basic design and dimensions of screw threads are in accordance with JIS B 0205.

## (For Adapters and Shafts)



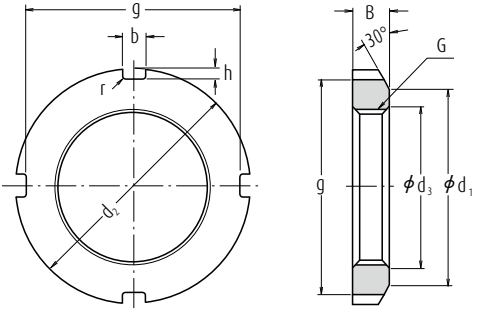

Nut with Stopper

Units : mm

| Nominal Numbers | Nut Series AN | | | | | | | | | | | | | Reference | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Screw Threads | Basic Dimensions | | | | | | | | Tapped Holes | | | Mass (kg) | Adapter (1) Sleeve Bore Dia. Numbers | Stopper Numbers | Shaft Dia. |
| | G | $d_2$ | $d_1$ | g | b | h | $d_3$ | B | r max. | l | Screw Threads (S) | $d_4$ | approx. | | | |
| **AN 44** | Tr 220×4 | 280 | 250 | 260 | 20 | 10 | 222 | 32 | 0.8 | 15 | M 8×1.25 | 238 | 5.2 | 44 | **AL 44** | 220 |
| **AN 48** | Tr 240×4 | 300 | 270 | 280 | 20 | 10 | 242 | 34 | 0.8 | 15 | M 8×1.25 | 258 | 5.95 | 48 | **AL 44** | 240 |
| **AN 52** | Tr 260×4 | 330 | 300 | 306 | 24 | 12 | 262 | 36 | 0.8 | 18 | M 10×1.5 | 281 | 8.05 | 52 | **AL 52** | 260 |
| **AN 56** | Tr 280×4 | 350 | 320 | 326 | 24 | 12 | 282 | 38 | 0.8 | 18 | M 10×1.5 | 301 | 9.05 | 56 | **AL 52** | 280 |
| **AN 60** | Tr 300×4 | 380 | 340 | 356 | 24 | 12 | 302 | 40 | 0.8 | 18 | M 10×1.5 | 326 | 11.8 | 60 | **AL 60** | 300 |
| **AN 64** | Tr 320×5 | 400 | 360 | 376 | 24 | 12 | 322.5 | 42 | 0.8 | 18 | M 10×1.5 | 345 | 13.1 | 64 | **AL 64** | 320 |
| **AN 68** | Tr 340×5 | 440 | 400 | 410 | 28 | 15 | 342.5 | 55 | 1 | 21 | M 12×1.75 | 372 | 23.1 | 68 | **AL 68** | 340 |
| **AN 72** | Tr 360×5 | 460 | 420 | 430 | 28 | 15 | 362.5 | 58 | 1 | 21 | M 12× 1.75 | 392 | 25.1 | 72 | **AL 68** | 360 |
| **AN 76** | Tr 380×5 | 490 | 450 | 454 | 32 | 18 | 382.5 | 60 | 1 | 21 | M 12×1.75 | 414 | 31 | 76 | **AL 76** | 380 |
| **AN 80** | Tr 400×5 | 520 | 470 | 484 | 32 | 18 | 402.5 | 62 | 1 | 27 | M 16×2 | 439 | 37 | 80 | **AL 80** | 400 |
| **AN 84** | Tr 420×5 | 540 | 490 | 504 | 32 | 18 | 422.5 | 70 | 1 | 27 | M 16×2 | 459 | 43.5 | 84 | **AL 80** | 420 |
| **AN 88** | Tr 440×5 | 560 | 510 | 520 | 36 | 20 | 442.5 | 70 | 1 | 27 | M 16×2 | 477 | 45 | 88 | **AL 88** | 440 |
| **AN 92** | Tr 460×5 | 580 | 540 | 540 | 36 | 20 | 462.5 | 75 | 1 | 27 | M 16×2 | 497 | 50.5 | 92 | **AL 88** | 460 |
| **AN 96** | Tr 480×5 | 620 | 560 | 580 | 36 | 20 | 482.5 | 75 | 1 | 27 | M 16×2 | 527 | 62 | 96 | **AL 96** | 480 |
| **AN 100** | Tr 500×5 | 630 | 580 | 584 | 40 | 23 | 502.5 | 80 | 1 | 27 | M 16×2 | 539 | 63.5 | /500 | **AL 100** | 500 |
| | **Nut Series ANL** | | | | | | | | | | | | | | | |
| **ANL 44** | Tr 220×4 | 260 | 242 | 242 | 20 | 9 | 222 | 30 | 0.8 | 12 | M 6×1 | 229 | 3.1 | 44 | **ALL 44** | 220 |
| **ANL 48** | Tr 240×4 | 290 | 270 | 270 | 20 | 10 | 242 | 34 | 0.8 | 15 | M 8×1.25 | 253 | 5.15 | 48 | **ALL 48** | 240 |
| **ANL 52** | Tr 260×4 | 310 | 290 | 290 | 20 | 10 | 262 | 34 | 0.8 | 15 | M 8×1.25 | 273 | 5.65 | 52 | **ALL 48** | 260 |
| **ANL 56** | Tr 280×4 | 330 | 310 | 310 | 24 | 10 | 282 | 38 | 0.8 | 15 | M 8×1.25 | 293 | 6.8 | 56 | **ALL 56** | 280 |
| **ANL 60** | Tr 300×4 | 360 | 336 | 336 | 24 | 12 | 302 | 42 | 0.8 | 15 | M 8×1.25 | 316 | 9.6 | 60 | **ALL 60** | 300 |
| **ANL 64** | Tr 320×5 | 380 | 356 | 356 | 24 | 12 | 322.5 | 42 | 0.8 | 15 | M 8×1.25 | 335 | 9.95 | 64 | **ALL 64** | 320 |
| **ANL 68** | Tr 340×5 | 400 | 376 | 376 | 24 | 12 | 342.5 | 45 | 1 | 15 | M 8×1.25 | 355 | 11.7 | 68 | **ALL 64** | 340 |
| **ANL 72** | Tr 360×5 | 420 | 394 | 394 | 28 | 13 | 362.5 | 45 | 1 | 15 | M 8×1.25 | 374 | 12 | 72 | **ALL 72** | 360 |
| **ANL 76** | Tr 380×5 | 450 | 422 | 422 | 28 | 14 | 382.5 | 48 | 1 | 18 | M 10×1.5 | 398 | 14.9 | 76 | **ALL 76** | 380 |
| **ANL 80** | Tr 400×5 | 470 | 442 | 442 | 28 | 14 | 402.5 | 52 | 1 | 18 | M 10×1.5 | 418 | 16.9 | 80 | **ALL 76** | 400 |
| **ANL 84** | Tr 420×5 | 490 | 462 | 462 | 32 | 14 | 422.5 | 52 | 1 | 18 | M 10×1.5 | 438 | 17.4 | 84 | **ALL 84** | 420 |
| **ANL 88** | Tr 440×5 | 520 | 490 | 490 | 32 | 15 | 442.5 | 60 | 1 | 21 | M 12×1.75 | 462 | 26.2 | 88 | **ALL 88** | 440 |
| **ANL 92** | Tr 460×5 | 540 | 510 | 510 | 32 | 15 | 462.5 | 60 | 1 | 21 | M 12×1.75 | 482 | 28 | 92 | **ALL 88** | 460 |
| **ANL 96** | Tr 480×5 | 560 | 530 | 530 | 36 | 15 | 482.5 | 60 | 1 | 21 | M 12×1.75 | 502 | 29.5 | 96 | **ALL 96** | 480 |
| **ANL 100** | Tr 500×5 | 580 | 550 | 550 | 36 | 15 | 502.5 | 68 | 1 | 21 | M 12×1.75 | 522 | 33.5 | /500 | **ALL 96** | 500 |

**Note** (1) Series AN is applicable to adapter sleeve Series A31, A32 and A23. Series ANL is applicable to adapter sleeve Series A30.

**Remarks**
1. The basic design and dimensions of screw threads are in accordance with JIS B 0216.
2. The basic design and dimensions of threads in tapped holes are in accordance with JIS B 0205.




Units : mm

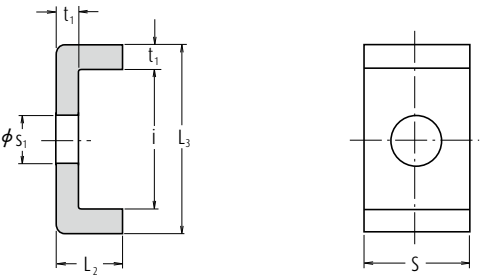
| Nominal Numbers | Nut Series HN | | | | | | | | | | Reference | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Screw Threads | Basic Dimensions | | | | | | | | Mass (kg) | Withdrawal Sleeve Numbers | | | |
| | G | $d_2$ | $d_1$ | g | b | h | $d_3$ | B | r max. | approx. | AH 31 | AH 22 | AH 32 | AH 23 |
| **HN 42** | Tr 210×4 | 270 | 238 | 250 | 20 | 10 | 212 | 30 | 0.8 | 4.75 | **AH 3138** | **AH 2238** | **AH 3238** | **AH 2338** |
| **HN 44** | Tr 220×4 | 280 | 250 | 260 | 20 | 10 | 222 | 32 | 0.8 | 5.35 | **AH 3140** | **AH 2240** | **AH 3240** | **AH 2340** |
| **HN 48** | Tr 240×4 | 300 | 270 | 280 | 20 | 10 | 242 | 34 | 0.8 | 6.2 | **AH 3144** | **AH 2244** | — | **AH 2344** |
| **HN 52** | Tr 260×4 | 330 | 300 | 306 | 24 | 12 | 262 | 36 | 0.8 | 8.55 | **AH 3148** | **AH 2248** | — | **AH 2348** |
| **HN 58** | Tr 290×4 | 370 | 330 | 346 | 24 | 12 | 292 | 40 | 0.8 | 11.8 | **AH 3152** | **AH 2252** | — | **AH 2352** |
| **HN 62** | Tr 310×5 | 390 | 350 | 366 | 24 | 12 | 312.5 | 42 | 0.8 | 13.4 | **AH 3156** | **AH 2256** | — | **AH 2356** |
| **HN 66** | Tr 330×5 | 420 | 380 | 390 | 28 | 15 | 332.5 | 52 | 1 | 20.4 | **AH 3160** | **AH 2260** | **AH 3260** | — |
| **HN 70** | Tr 350×5 | 450 | 410 | 420 | 28 | 15 | 352.5 | 55 | 1 | 25.2 | **AH 3164** | **AH 2264** | **AH 3264** | — |
| **HN 74** | Tr 370×5 | 470 | 430 | 440 | 28 | 15 | 372.5 | 58 | 1 | 28.2 | **AH 3168** | — | **AH 3268** | — |
| **HN 80** | Tr 400×5 | 520 | 470 | 484 | 32 | 18 | 402.5 | 62 | 1 | 40 | **AH 3172** | — | **AH 3272** | — |
| **HN 84** | Tr 420×5 | 540 | 490 | 504 | 32 | 18 | 422.5 | 70 | 1 | 46.9 | **AH 3176** | — | **AH 3276** | — |
| **HN 88** | Tr 440×5 | 560 | 510 | 520 | 36 | 20 | 442.5 | 70 | 1 | 48.5 | **AH 3180** | — | **AH 3280** | — |
| **HN 92** | Tr 460×5 | 580 | 540 | 540 | 36 | 20 | 462.5 | 75 | 1 | 55 | **AH 3184** | — | **AH 3284** | — |
| **HN 96** | Tr 480×5 | 620 | 560 | 580 | 36 | 20 | 482.5 | 75 | 1 | 67 | **AHX 3188** | — | **AHX 3288** | — |
| **HN 102** | Tr 510×6 | 650 | 590 | 604 | 40 | 23 | 513 | 80 | 1 | 75 | **AHX 3192** | — | **AHX 3292** | — |
| **HN 106** | Tr 530×6 | 670 | 610 | 624 | 40 | 23 | 533 | 80 | 1 | 78 | **AHX 3196** | — | **AHX 3296** | — |
| **HN 110** | Tr 550×6 | 700 | 640 | 654 | 40 | 23 | 553 | 80 | 1 | 92.5 | **AHX 31/500** | — | **AHX 32/500** | — |
| | **Nut Series HNL** | | | | | | | | | | **AH 30** | **AH 2** | | |
| **HNL 41** | Tr 205×4 | 250 | 232 | 234 | 18 | 8 | 207 | 30 | 0.8 | 3.45 | **AH 3038** | **AH 238** | | |
| **HNL 43** | Tr 215×4 | 260 | 242 | 242 | 20 | 9 | 217 | 30 | 0.8 | 3.7 | **AH 3040** | **AH 240** | | |
| **HNL 47** | Tr 235×4 | 280 | 262 | 262 | 20 | 9 | 237 | 34 | 0.8 | 4.6 | **AH 3044** | **AH 244** | | |
| **HNL 52** | Tr 260×4 | 310 | 290 | 290 | 20 | 10 | 262 | 34 | 0.8 | 5.8 | **AH 3048** | **AH 248** | | |
| **HNL 56** | Tr 280×4 | 330 | 310 | 310 | 24 | 10 | 282 | 38 | 0.8 | 6.7 | **AH 3052** | **AH 252** | | |
| **HNL 60** | Tr 300×4 | 360 | 336 | 336 | 24 | 12 | 302 | 42 | 0.8 | 9.6 | **AH 3056** | **AH 256** | | |
| **HNL 64** | Tr 320×5 | 380 | 356 | 356 | 24 | 12 | 322.5 | 42 | 1 | 10.3 | **AH 3060** | — | | |
| **HNL 69** | Tr 345×5 | 410 | 384 | 384 | 28 | 13 | 347.5 | 45 | 1 | 11.5 | **AH 3064** | — | | |
| **HNL 73** | Tr 365×5 | 430 | 404 | 404 | 28 | 13 | 367.5 | 48 | 1 | 14.2 | **AH 3068** | — | | |
| **HNL 77** | Tr 385×5 | 450 | 422 | 422 | 28 | 14 | 387.5 | 48 | 1 | 15 | **AH 3072** | — | | |
| **HNL 82** | Tr 410×5 | 480 | 452 | 452 | 32 | 14 | 412.5 | 52 | 1 | 19 | **AH 3076** | — | | |
| **HNL 86** | Tr 430×5 | 500 | 472 | 472 | 32 | 14 | 432.5 | 52 | 1 | 19.8 | **AH 3080** | — | | |
| **HNL 90** | Tr 450×5 | 520 | 490 | 490 | 32 | 15 | 452.5 | 60 | 1 | 23.8 | **AH 3084** | — | | |
| **HNL 94** | Tr 470×5 | 540 | 510 | 510 | 32 | 15 | 472.5 | 60 | 1 | 25 | **AHX 3088** | — | | |
| **HNL 98** | Tr 490×5 | 580 | 550 | 550 | 36 | 15 | 492.5 | 60 | 1 | 34 | **AHX 3092** | — | | |
| **HNL 104** | Tr 520×6 | 600 | 570 | 570 | 36 | 15 | 523 | 68 | 1 | 37 | **AHX 3096** | — | | |
| **HNL 108** | Tr 540×6 | 630 | 590 | 590 | 40 | 20 | 543 | 68 | 1 | 43.5 | **AHX 30/500** | — | | |

**Remarks** 1. The basic design and dimensions of screw threads are in accordance with JIS B 0216.
2. The number of notches in the nut may be bigger than that shown in the above figure.

## (Combination of Withdrawal Sleeves and Nuts)

| Nominal Numbers | Reference Withdrawal Sleeve Numbers | | | | | | |
|---|---|---|---|---|---|---|---|
| | AH 30 | AH 31 | AH 2 | AH 22 | AH 32 | AH 3 | AH 23 |
| AN 09 | – | – | AH 208 | – | – | AH 308 | AH 2308 |
| AN 10 | – | – | AH 209 | – | – | AH 309 | AH 2309 |
| AN 11 | – | – | AH 210 | – | – | AHX 310 | AHX 2310 |
| AN 12 | – | – | AH 211 | – | – | AHX 311 | AHX 2311 |
| AN 13 | – | – | AH 212 | – | – | AHX 312 | AHX 2312 |
| AN 14 | – | – | – | – | – | – | – |
| AN 15 | – | – | AH 213 | – | – | AH 313 | AH 2313 |
| AN 16 | – | – | AH 214 | – | – | AH 314 | AHX 2314 |
| AN 17 | – | – | AH 215 | – | – | AH 315 | AHX 2315 |
| AN 18 | – | – | AH 216 | – | – | AH 316 | AHX 2316 |
| AN 19 | – | – | AH 217 | – | – | AHX 317 | AHX 2317 |
| AN 20 | – | – | AH 218 | – | AHX 3218 | AHX 318 | AHX 2318 |
| AN 21 | – | – | AH 219 | – | – | AHX 319 | AHX 2319 |
| AN 22 | – | – | AH 220 | – | AHX 3220 | AHX 320 | AHX 2320 |
| AN 23 | – | – | AH 221 | – | – | AHX 321 | – |
| AN 24 | – | AHX 3122 | AH 222 | – | – | AHX 322 | – |
| AN 25 | – | – | – | – | AHX 3222 | – | AHX 2322 |
| AN 26 | AHX 3024 | AHX 3124 | AH 224 | – | – | AHX 324 | – |
| AN 27 | – | – | – | – | AHX 3224 | – | AHX 2324 |
| AN 28 | AHX 3026 | AHX 3126 | AH 226 | – | – | AHX 326 | – |
| AN 29 | – | – | – | – | AHX 3226 | – | AHX 2326 |
| AN 30 | AHX 3028 | AHX 3128 | AH 228 | – | – | AHX 328 | – |
| AN 31 | – | – | – | – | AHX 3228 | – | AHX 2328 |
| AN 32 | AHX 3030 | – | AH 230 | – | – | – | – |
| AN 33 | – | AHX 3130 | – | – | AHX 3230 | AHX 330 | AHX 2330 |
| AN 34 | AH 3032 | – | AH 232 | – | – | – | – |
| AN 36 | AH 3034 | AH 3132 | AH 234 | – | AH 3232 | AH 332 | AH 2332 |
| AN 38 | AH 3036 | AH 3134 | AH 236 | – | AH 3234 | AH 334 | AH 2334 |
| AN 40 | – | AH 3136 | – | AH 2236 | AH 3236 | – | AH 2336 |

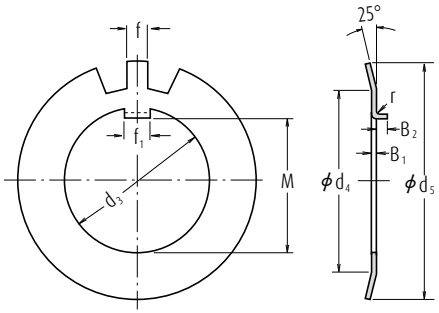
# Stoppers for Nuts



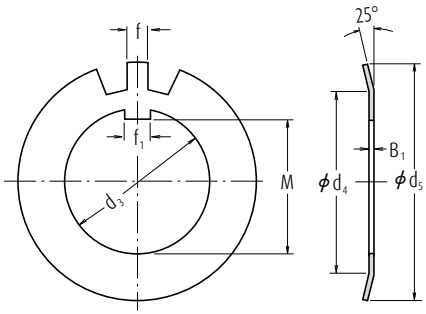

Units : mm

| Nominal Numbers | Stopper Series AL | | | | | | | Reference |
|---|---|---|---|---|---|---|---|---|
| | Basic Dimensions | | | | | | Mass (kg) per 100 pcs | Nut Numbers |
| | $t_1$ | S | $L_2$ | $s_1$ | i | $L_3$ | approx. | |
| **AL 44** | 4 | 20 | 12 | 9 | 22.5 | 30.5 | 2.6 | **AN 44, AN 48** |
| **AL 52** | 4 | 24 | 12 | 12 | 25.5 | 33.5 | 3.4 | **AN 52, AN 56** |
| **AL 60** | 4 | 24 | 12 | 12 | 30.5 | 38.5 | 3.8 | **AN 60** |
| **AL 64** | 5 | 24 | 15 | 12 | 31 | 41 | 5.35 | **AN 64** |
| **AL 68** | 5 | 28 | 15 | 14 | 38 | 48 | 6.65 | **AN 68, AN 72** |
| **AL 76** | 5 | 32 | 15 | 14 | 40 | 50 | 7.95 | **AN 76** |
| **AL 80** | 5 | 32 | 15 | 18 | 45 | 55 | 8.2 | **AN 80, AN 84** |
| **AL 88** | 5 | 36 | 15 | 18 | 43 | 53 | 9.0 | **AN 88, AN 92** |
| **AL 96** | 5 | 36 | 15 | 18 | 53 | 63 | 10.4 | **AN 96** |
| **AL 100** | 5 | 40 | 15 | 18 | 45 | 55 | 10.5 | **AN 100** |
| **Stopper Series ALL** | | | | | | | | |
| **ALL 44** | 4 | 20 | 12 | 7 | 13.5 | 21.5 | 2.12 | **ANL 44** |
| **ALL 48** | 4 | 20 | 12 | 9 | 17.5 | 25.5 | 2.29 | **ANL 48, ANL 52** |
| **ALL 56** | 4 | 24 | 12 | 9 | 17.5 | 25.5 | 2.92 | **ANL 56** |
| **ALL 60** | 4 | 24 | 12 | 9 | 20.5 | 28.5 | 3.15 | **ANL 60** |
| **ALL 64** | 5 | 24 | 15 | 9 | 21 | 31 | 4.55 | **ANL 64, ANL 68** |
| **ALL 72** | 5 | 28 | 15 | 9 | 20 | 30 | 5.05 | **ANL 72** |
| **ALL 76** | 5 | 28 | 15 | 12 | 24 | 34 | 5.3 | **ANL 76, ANL 80** |
| **ALL 84** | 5 | 32 | 15 | 12 | 24 | 34 | 6.1 | **ANL 84** |
| **ALL 88** | 5 | 32 | 15 | 14 | 28 | 38 | 6.45 | **ANL 88, ANL 92** |
| **ALL 96** | 5 | 36 | 15 | 14 | 28 | 38 | 7.3 | **ANL 96, ANL 100** |

# Lock-Washers for Rolling Bearings




Bent-Tab



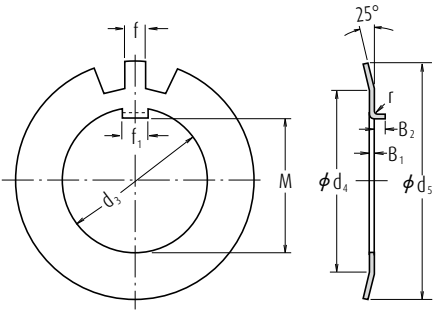

Straight-Tab

Units : mm

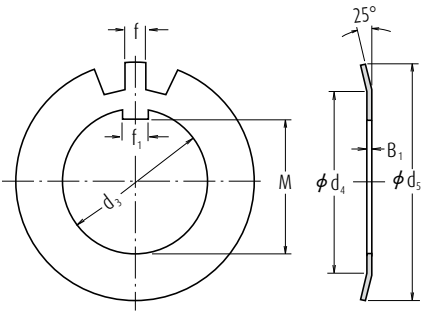
| Nominal Numbers | | Lock-washer Series AW | | | | | | | | | | | Reference | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Basic Dimensions | | | | | | | | | No. of Teeth | Mass (kg) per 100 pcs approx. | Adapter (1) Sleeve Bore Dia. Numbers | Nut Numbers | Shaft Dia. |
| Bent-Tab | Straight-Tab | $d_3$ | M | $f_1$ | $B_1$ | f | $d_4$ | $d_5$ | Bent-Tab r | Bent-Tab $B_2$ | | | | | |
| AW 02 | AW 02 X | 15 | 13.5 | 4 | 1 | 4 | 21 | 28 | 1 | 2.5 | 13 | 0.253 | – | AN 02 | 15 |
| AW 03 | AW 03 X | 17 | 15.5 | 4 | 1 | 4 | 24 | 32 | 1 | 2.5 | 13 | 0.315 | – | AN 03 | 17 |
| AW 04 | AW 04 X | 20 | 18.5 | 4 | 1 | 4 | 26 | 36 | 1 | 2.5 | 13 | 0.35 | 04 | AN 04 | 20 |
| AW 05 | AW 05 X | 25 | 23 | 5 | 1.2 | 5 | 32 | 42 | 1 | 2.5 | 13 | 0.64 | 05 | AN 05 | 25 |
| AW 06 | AW 06 X | 30 | 27.5 | 5 | 1.2 | 5 | 38 | 49 | 1 | 2.5 | 13 | 0.78 | 06 | AN 06 | 30 |
| AW 07 | AW 07 X | 35 | 32.5 | 6 | 1.2 | 5 | 44 | 57 | 1 | 2.5 | 15 | 1.04 | 07 | AN 07 | 35 |
| AW 08 | AW 08 X | 40 | 37.5 | 6 | 1.2 | 6 | 50 | 62 | 1 | 2.5 | 15 | 1.23 | 08 | AN 08 | 40 |
| AW 09 | AW 09 X | 45 | 42.5 | 6 | 1.2 | 6 | 56 | 69 | 1 | 2.5 | 17 | 1.52 | 09 | AN 09 | 45 |
| AW 10 | AW 10 X | 50 | 47.5 | 6 | 1.2 | 6 | 61 | 74 | 1 | 2.5 | 17 | 1.6 | 10 | AN 10 | 50 |
| AW 11 | AW 11 X | 55 | 52.5 | 8 | 1.2 | 7 | 67 | 81 | 1 | 4 | 17 | 1.96 | 11 | AN 11 | 55 |
| AW 12 | AW 12 X | 60 | 57.5 | 8 | 1.5 | 7 | 73 | 86 | 1.2 | 4 | 17 | 2.53 | 12 | AN 12 | 60 |
| AW 13 | AW 13 X | 65 | 62.5 | 8 | 1.5 | 7 | 79 | 92 | 1.2 | 4 | 19 | 2.9 | 13 | AN 13 | 65 |
| AW 14 | AW 14 X | 70 | 66.5 | 8 | 1.5 | 8 | 85 | 98 | 1.2 | 4 | 19 | 3.35 | 14 | AN 14 | 70 |
| AW 15 | AW 15 X | 75 | 71.5 | 8 | 1.5 | 8 | 90 | 104 | 1.2 | 4 | 19 | 3.55 | 15 | AN 15 | 75 |
| AW 16 | AW 16 X | 80 | 76.5 | 10 | 1.8 | 8 | 95 | 112 | 1.2 | 4 | 19 | 4.65 | 16 | AN 16 | 80 |
| AW 17 | AW 17 X | 85 | 81.5 | 10 | 1.8 | 8 | 102 | 119 | 1.2 | 4 | 19 | 5.25 | 17 | AN 17 | 85 |
| AW 18 | AW 18 X | 90 | 86.5 | 10 | 1.8 | 10 | 108 | 126 | 1.2 | 4 | 19 | 6.25 | 18 | AN 18 | 90 |
| AW 19 | AW 19 X | 95 | 91.5 | 10 | 1.8 | 10 | 113 | 133 | 1.2 | 4 | 19 | 6.7 | 19 | AN 19 | 95 |
| AW 20 | AW 20 X | 100 | 96.5 | 12 | 1.8 | 10 | 120 | 142 | 1.2 | 6 | 19 | 7.65 | 20 | AN 20 | 100 |
| AW 21 | AW 21 X | 105 | 100.5 | 12 | 1.8 | 12 | 126 | 145 | 1.2 | 6 | 19 | 8.25 | 21 | AN 21 | 105 |
| AW 22 | AW 22 X | 110 | 105.5 | 12 | 1.8 | 12 | 133 | 154 | 1.2 | 6 | 19 | 9.4 | 22 | AN 22 | 110 |
| AW 23 | AW 23 X | 115 | 110.5 | 12 | 2 | 12 | 137 | 159 | 1.5 | 6 | 19 | 10.8 | – | AN 23 | 115 |
| AW 24 | AW 24 X | 120 | 115 | 14 | 2 | 12 | 138 | 164 | 1.5 | 6 | 19 | 10.5 | 24 | AN 24 | 120 |
| AW 25 | AW 25 X | 125 | 120 | 14 | 2 | 12 | 148 | 170 | 1.5 | 6 | 19 | 11.8 | – | AN 25 | 125 |

**Note** (1) Applicable to adapter sleeve Series A31, A2, A3, and A23.

**Remark** Lock-washers with straight tabs shall be used with adapter sleeves having narrow slits. For adapter sleeves having wide slits, either type of lock-washer may be used.




Bent-Tab




Straight-Tab

Units : mm

| Nominal Numbers | | Lock-washer Series AW | | | | | | | | | | | Reference | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Basic Dimensions | | | | | | | | | No. of Teeth | Mass (kg) per 100 pcs approx. | Adapter (1) Sleeve Bore Dia. Numbers | Nut Numbers | Shaft Dia. |
| Bent-Tab | Straight-Tab | $d_3$ | M | $f_1$ | $B_1$ | f | $d_4$ | $d_5$ | Bent-Tab r | Bent-Tab $B_2$ | | | | | |
| **AW 26** | **AW 26 X** | 130 | 125 | 14 | 2 | 12 | 149 | 175 | 1.5 | 6 | 19 | 11.3 | 26 | **AN 26** | 130 |
| **AW 27** | **AW 27 X** | 135 | 130 | 14 | 2 | 14 | 160 | 185 | 1.5 | 6 | 19 | 14.4 | — | **AN 27** | 135 |
| **AW 28** | **AW 28 X** | 140 | 135 | 16 | 2 | 14 | 160 | 192 | 1.5 | 8 | 19 | 14.2 | 28 | **AN 28** | 140 |
| **AW 29** | **AW 29 X** | 145 | 140 | 16 | 2 | 14 | 172 | 202 | 1.5 | 8 | 19 | 16.8 | — | **AN 29** | 145 |
| **AW 30** | **AW 30 X** | 150 | 145 | 16 | 2 | 14 | 171 | 205 | 1.5 | 8 | 19 | 15.9 | 30 | **AN 30** | 150 |
| **AW 31** | **AW 31 X** | 155 | 147.5 | 16 | 2.5 | 16 | 182 | 212 | 1.5 | 8 | 19 | 20.9 | — | **AN 31** | 155 |
| **AW 32** | **AW 32 X** | 160 | 154 | 18 | 2.5 | 16 | 182 | 217 | 1.5 | 8 | 19 | 22.2 | 32 | **AN 32** | 160 |
| **AW 33** | **AW 33 X** | 165 | 157.5 | 18 | 2.5 | 16 | 193 | 222 | 1.5 | 8 | 19 | 24.1 | — | **AN 33** | 165 |
| **AW 34** | **AW 34 X** | 170 | 164 | 18 | 2.5 | 16 | 193 | 232 | 1.5 | 8 | 19 | 24.7 | 34 | **AN 34** | 170 |
| **AW 36** | **AW 36 X** | 180 | 174 | 20 | 2.5 | 18 | 203 | 242 | 1.5 | 8 | 19 | 26.8 | 36 | **AN 36** | 180 |
| **AW 38** | **AW 38 X** | 190 | 184 | 20 | 2.5 | 18 | 214 | 252 | 1.5 | 8 | 19 | 27.8 | 38 | **AN 38** | 190 |
| **AW 40** | **AW 40 X** | 200 | 194 | 20 | 2.5 | 18 | 226 | 262 | 1.5 | 8 | 19 | 29.3 | 40 | **AN 40** | 200 |
| **Washer Series AWL** | | | | | | | | | | | | | | | |
| **AWL 24** | **AWL 24 X** | 120 | 115 | 14 | 2 | 12 | 133 | 155 | 1.5 | 6 | 19 | 7.7 | 24 | **ANL 24** | 120 |
| **AWL 26** | **AWL 26 X** | 130 | 125 | 14 | 2 | 12 | 143 | 165 | 1.5 | 6 | 19 | 8.7 | 26 | **ANL 26** | 130 |
| **AWL 28** | **AWL 28 X** | 140 | 135 | 16 | 2 | 14 | 151 | 175 | 1.5 | 8 | 19 | 10.9 | 28 | **ANL 28** | 140 |
| **AWL 30** | **AWL 30 X** | 150 | 145 | 16 | 2 | 14 | 164 | 190 | 1.5 | 8 | 19 | 11.3 | 30 | **ANL 30** | 150 |
| **AWL 32** | **AWL 32 X** | 160 | 154 | 18 | 2.5 | 16 | 174 | 200 | 1.5 | 8 | 19 | 16.2 | 32 | **ANL 32** | 160 |
| **AWL 34** | **AWL 34 X** | 170 | 164 | 18 | 2.5 | 16 | 184 | 210 | 1.5 | 8 | 19 | 19 | 34 | **ANL 34** | 170 |
| **AWL 36** | **AWL 36 X** | 180 | 174 | 20 | 2.5 | 18 | 192 | 220 | 1.5 | 8 | 19 | 18 | 36 | **ANL 36** | 180 |
| **AWL 38** | **AWL 38 X** | 190 | 184 | 20 | 2.5 | 18 | 202 | 230 | 1.5 | 8 | 19 | 20.5 | 38 | **ANL 38** | 190 |
| **AWL 40** | **AWL 40 X** | 200 | 194 | 20 | 2.5 | 18 | 218 | 250 | 1.5 | 8 | 19 | 21.4 | 40 | **ANL 40** | 200 |

**Note** (1) Series AW is applicable to adapter sleeve Series A31 and A23.
Series AWL is applicable to adapter sleeve Series A30.

**Remark** Lock-washers with straight tabs shall be used with adapter sleeves having narrow slits. For adapter sleeves having wide slits, either type of lock-washer may be used.

# Notes

# APPENDICES


Appendix Table 1 Conversion Table from SI (International Units) System ..... C 002

Appendix Table 2 N – kgf Force Conversion Table ..... C 004

Appendix Table 3 kg – lb Mass Conversion Table ..... C 005

Appendix Table 4 °C – °F Temperature Conversion Table ..... C 006

Appendix Table 5 Viscosity Conversion Table ..... C 007

Appendix Table 6 inch – mm Conversion Table ..... C 008

Appendix Table 7 Hardness Conversion Table ..... C 010

Appendix Table 8 Physical and Mechanical Properties of Materials ..... C 011

Appendix Table 9 Tolerances for Shaft Diameters ..... C 012

Appendix Table 10 Tolerances for Housing Bore Diameters ..... C 014

Appendix Table 11 Values of Standard Tolerance Grades IT ..... C 016

Appendix Table 12 Speed Factor $f_n$ ..... C 018

Appendix Table 13 Fatigue Life Factor $f_h$ and Fatigue Life $L - L_h$ ..... C 019

Appendix Table 14 Index of Inch Design Tapered Roller Bearings ..... C 020

## Appendix Table 1 Conversion Table from SI (International Units) System

### Comparison of SI, CGS, and Engineering Units

| Units / Unit System | Length | Mass | Time | Temp. | Acceleration | Force | Stress | Pressure | Energy | Power |
|---|---|---|---|---|---|---|---|---|---|---|
| **SI** | **m** | **kg** | **s** | **K, °C** | **$m/s^2$** | **N** | **Pa** | **Pa** | **J** | **W** |
| CGS System | cm | g | s | °C | Gal | dyn | $dyn/cm^2$ | $dyn/cm^2$ | erg | erg/s |
| Engineering Unit System | m | $kgf \cdot s^2/m$ | s | °C | $m/s^2$ | kgf | $kgf/m^2$ | $kgf/m^2$ | $kgf \cdot m$ | $kgf \cdot m/s$ |

### Conversion Factors from SI Units

| Parameter | SI Units | | Units other than SI | | Conversion Factors from SI Units |
|---|---|---|---|---|---|
| | Names of Units | Symbols | Name of Units | Symbols | |
| Angle | **Radian** | **rad** | Degree | ° | $180/\pi$ |
| | | | Minute | ′ | $10\ 800/\pi$ |
| | | | Second | ″ | $648\ 000/\pi$ |
| Length | **Meter** | **m** | Micron | μ | $10^6$ |
| | | | Angstrom | Å | $10^{10}$ |
| Area | **Square meter** | **$m^2$** | Are | a | $10^{-2}$ |
| | | | Hectare | ha | $10^{-4}$ |
| Volume | **Cubic meter** | **$m^3$** | Liter | l, L | $10^3$ |
| | | | Deciliter | dl, dL | $10^4$ |
| Time | **Second** | **s** | Minute | min | 1/60 |
| | | | Hour | h | 1/3 600 |
| | | | Day | d | 1/86 400 |
| Frequency | **Hertz** | **Hz** | Cycle | $s^{-1}$ | 1 |
| Speed of Rotation | **Revolution per second** | **$s^{-1}$** | Revolution per miunte | rpm | 60 |
| Speed | **Meter per second** | **m/s** | Kilometer per hour | km/h | 3 600/1 000 |
| | | | Knot | kn | 3 600/1 852 |
| Acceleration | **Meter per second per second** | **$m/s^2$** | Gal | Gal | $10^2$ |
| | | | g | G | 1/9.806 65 |
| Mass | **Kilogram** | **kg** | Ton | t | $10^{-3}$ |
| Force | **Newton** | **N** | Kilogram-force | kgf | 1/9.806 65 |
| | | | Ton-force | tf | $1/ (9.806\ 65 \times 10^3)$ |
| | | | Dyne | dyn | $10^5$ |
| Torque or Moment | **Newton · meter** | **N · m** | Kilogram-force meter | kgf · m | 1/9.806 65 |
| Stress | **Pascal** | **Pa** | Kilogram-force per square centimeter | $kgf/cm^2$ | $1/ (9.806\ 65 \times 10^4)$ |
| | | **($N/m^2$)** | Kilogram-force per square millimeter | $kgf/mm^2$ | $1/ (9.806\ 65 \times 10^6)$ |

## Prefixes Used In SI System

| Multiples | Prefix | Symbols | Multiples | Prefix | Symbols |
|---|---|---|---|---|---|
| $10^{18}$ | Exa | E | $10^{-1}$ | Deci | d |
| $10^{15}$ | Peta | P | $10^{-2}$ | Centi | c |
| $10^{12}$ | Tera | T | $10^{-3}$ | Milli | m |
| $10^{9}$ | Giga | G | $10^{-6}$ | Micro | μ |
| $10^{6}$ | Mega | M | $10^{-9}$ | Nano | n |
| $10^{3}$ | Kilo | k | $10^{-12}$ | Pico | p |
| $10^{2}$ | Hecto | h | $10^{-15}$ | Femto | f |
| 10 | Deca | da | $10^{-18}$ | Ato | a |

## Conversion Factors from SI Units (Continued)

| Parameter | SI Units | | Units other than SI | | Conversion Factors from SI Units |
|---|---|---|---|---|---|
| | Names of Units | Symbols | Names of Units | Units | |
| Pressure | **Pascal** | **Pa** | Kilogram-force per square meter | $kgf/m^2$ | 1/9.806 65 |
| | **(Newton per square meter)** | **($N/m^2$)** | Water Column | $mH_2O$ | $1/(9.806\ 65\times10^3)$ |
| | | | Mercury Column | mmHg | $760/(1.013\ 25\times10^5)$ |
| | | | Torr | Torr | $760/(1.013\ 25\times10^5)$ |
| | | | Bar | bar | $10^{-5}$ |
| | | | Atmosphere | atm | $1/(1.013\ 25\times10^5)$ |
| Energy | **Joule** | **J** | Erg | erg | $10^7$ |
| | **(Newton · meter)** | **(N · m)** | Calorie (International) | $cal_{IT}$ | 1/4.186 8 |
| | | | Kilogram-force meter | kgf · m | 1/9.806 65 |
| | | | Kilowatt hour | kW · h | $1/(3.6\times10^6)$ |
| | | | French horse power hour | PS · h | $\approx 3.776\ 72\times10^{-7}$ |
| Work | **Watt** | **W** | Kilogram-force meter per second | kgf · m/s | 1/9.806 65 |
| | **(Joule per second)** | **(J/s)** | Kilocalorie per hour | kcal/h | 1/1.163 |
| | | | French horse power | PS | $\approx 1/735.498\ 8$ |
| Viscosity, Viscosity Index | **Pascal second** | **Pa · s** | Poise | P | 10 |
| Kinematic Viscosity, Kinematic Viscosity Index | **Square meter per second** | **$m^2/s$** | Stokes | St | $10^4$ |
| | | | Centistokes | cSt | $10^6$ |
| Temperature | **Kelvin, Degree celsius** | **K, °C** | Degree | °C | (See note (1)) |
| Electric Current, Magnetomotive Force | **Ampere** | **A** | Ampere | A | 1 |
| Voltage, Electromotive Force | **Volt** | **V** | (Watts per ampere) | (W/A) | 1 |
| Magnetic Field Strength | **Ampere per meter** | **A/m** | Oersted | Oe | $4\pi/10^3$ |
| Magnetic Flux | **Tesla** | **T** | Gauss | Gs | $10^4$ |
| Density | | | Gamma | γ | $10^9$ |
| Electrical Resistance | **Ohm** | **Ω** | (Volts per ampere) | (V/A) | 1 |

**Note** (1) The conversion from TK into θ°C is θ=T−273.15 but for a temperature difference, it is $\Delta T=\Delta\theta$. However, $\Delta T$ and $\Delta\theta$ represent temperature differences measured using the Kelvin and Celsius scales respectively.

**Remarks** The names and symbols in ( ) are equivalent to those directly above them or on their left.

Example of conversion 1N=1/9.806 65kgf

## Appendix Table 2 N - kgf Force Conversion Table

[Method of using this table] For example, to convert 10 N into kgf, read the figure in the right kgf column adjacent to the 10 in the center column in the 1st block. This means that 10 N is 1.0197 kgf. To convert 10 kgf into N, read the figure in the left N column of the same row, which indicates that the answer is 98.066 N.

1 N = 0.1019716 kgf
1 kgf = 9.80665 N

| N | | kgf | N | | kgf | N | | kgf |
|---|---|---|---|---|---|---|---|---|
| 9.8066 | **1** | 0.1020 | 333.43 | **34** | 3.4670 | 657.05 | **67** | 6.8321 |
| 19.613 | **2** | 0.2039 | 343.23 | **35** | 3.5690 | 666.85 | **68** | 6.9341 |
| 29.420 | **3** | 0.3059 | 353.04 | **36** | 3.6710 | 676.66 | **69** | 7.0360 |
| 39.227 | **4** | 0.4079 | 362.85 | **37** | 3.7729 | 686.47 | **70** | 7.1380 |
| 49.033 | **5** | 0.5099 | 372.65 | **38** | 3.8749 | 696.27 | **71** | 7.2400 |
| 58.840 | **6** | 0.6118 | 382.46 | **39** | 3.9769 | 706.08 | **72** | 7.3420 |
| 68.647 | **7** | 0.7138 | 392.27 | **40** | 4.0789 | 715.89 | **73** | 7.4439 |
| 78.453 | **8** | 0.8158 | 402.07 | **41** | 4.1808 | 725.69 | **74** | 7.5459 |
| 88.260 | **9** | 0.9177 | 411.88 | **42** | 4.2828 | 735.50 | **75** | 7.6479 |
| 98.066 | **10** | 1.0197 | 421.69 | **43** | 4.3848 | 745.31 | **76** | 7.7498 |
| 107.87 | **11** | 1.1217 | 431.49 | **44** | 4.4868 | 755.11 | **77** | 7.8518 |
| 117.68 | **12** | 1.2237 | 441.30 | **45** | 4.5887 | 764.92 | **78** | 7.9538 |
| 127.49 | **13** | 1.3256 | 451.11 | **46** | 4.6907 | 774.73 | **79** | 8.0558 |
| 137.29 | **14** | 1.4276 | 460.91 | **47** | 4.7927 | 784.53 | **80** | 8.1577 |
| 147.10 | **15** | 1.5296 | 470.72 | **48** | 4.8946 | 794.34 | **81** | 8.2597 |
| 156.91 | **16** | 1.6315 | 480.53 | **49** | 4.9966 | 804.15 | **82** | 8.3617 |
| 166.71 | **17** | 1.7335 | 490.33 | **50** | 5.0986 | 813.95 | **83** | 8.4636 |
| 176.52 | **18** | 1.8355 | 500.14 | **51** | 5.2006 | 823.76 | **84** | 8.5656 |
| 186.33 | **19** | 1.9375 | 509.95 | **52** | 5.3025 | 833.57 | **85** | 8.6676 |
| 196.13 | **20** | 2.0394 | 519.75 | **53** | 5.4045 | 843.37 | **86** | 8.7696 |
| 205.94 | **21** | 2.1414 | 529.56 | **54** | 5.5065 | 853.18 | **87** | 8.8715 |
| 215.75 | **22** | 2.2434 | 539.37 | **55** | 5.6084 | 862.99 | **88** | 8.9735 |
| 225.55 | **23** | 2.3453 | 549.17 | **56** | 5.7104 | 872.79 | **89** | 9.0755 |
| 235.36 | **24** | 2.4473 | 558.98 | **57** | 5.8124 | 882.60 | **90** | 9.1774 |
| 245.17 | **25** | 2.5493 | 568.79 | **58** | 5.9144 | 892.41 | **91** | 9.2794 |
| 254.97 | **26** | 2.6513 | 578.59 | **59** | 6.0163 | 902.21 | **92** | 9.3814 |
| 264.78 | **27** | 2.7532 | 588.40 | **60** | 6.1183 | 912.02 | **93** | 9.4834 |
| 274.59 | **28** | 2.8552 | 598.21 | **61** | 6.2203 | 921.83 | **94** | 9.5853 |
| 284.39 | **29** | 2.9572 | 608.01 | **62** | 6.3222 | 931.63 | **95** | 9.6873 |
| 294.20 | **30** | 3.0591 | 617.82 | **63** | 6.4242 | 941.44 | **96** | 9.7893 |
| 304.01 | **31** | 3.1611 | 627.63 | **64** | 6.5262 | 951.25 | **97** | 9.8912 |
| 313.81 | **32** | 3.2631 | 637.43 | **65** | 6.6282 | 961.05 | **98** | 9.9932 |
| 323.62 | **33** | 3.3651 | 647.24 | **66** | 6.7301 | 970.86 | **99** | 10.095 |

## Appendix Table 3 kg - lb Mass Conversion Table

**[Method of using this table]** For example, to convert 10 kg into lb, read the figure in the right lb column adjacent to the 10 in the center column in the 1st block. This means that 10 kg is 22.046 lb. To convert 10 lb into kg, read the figure in the left kg column of the same row, which indicates that the answer is 4.536 kg.

1 kg = 2.2046226 lb
1 lb = 0.45359237 kg

| kg | | lb | kg | | lb | kg | | lb |
|---|---|---|---|---|---|---|---|---|
| 0.454 | **1** | 2.205 | 15.422 | **34** | 74.957 | 30.391 | **67** | 147.71 |
| 0.907 | **2** | 4.409 | 15.876 | **35** | 77.162 | 30.844 | **68** | 149.91 |
| 1.361 | **3** | 6.614 | 16.329 | **36** | 79.366 | 31.298 | **69** | 152.12 |
| 1.814 | **4** | 8.818 | 16.783 | **37** | 81.571 | 31.751 | **70** | 154.32 |
| 2.268 | **5** | 11.023 | 17.237 | **38** | 83.776 | 32.205 | **71** | 156.53 |
| 2.722 | **6** | 13.228 | 17.690 | **39** | 85.980 | 32.659 | **72** | 158.73 |
| 3.175 | **7** | 15.432 | 18.144 | **40** | 88.185 | 33.112 | **73** | 160.94 |
| 3.629 | **8** | 17.637 | 18.597 | **41** | 90.390 | 33.566 | **74** | 163.14 |
| 4.082 | **9** | 19.842 | 19.051 | **42** | 92.594 | 34.019 | **75** | 165.35 |
| 4.536 | **10** | 22.046 | 19.504 | **43** | 94.799 | 34.473 | **76** | 167.55 |
| 4.990 | **11** | 24.251 | 19.958 | **44** | 97.003 | 34.927 | **77** | 169.76 |
| 5.443 | **12** | 26.455 | 20.412 | **45** | 99.208 | 35.380 | **78** | 171.96 |
| 5.897 | **13** | 28.660 | 20.865 | **46** | 101.41 | 35.834 | **79** | 174.17 |
| 6.350 | **14** | 30.865 | 21.319 | **47** | 103.62 | 36.287 | **80** | 176.37 |
| 6.804 | **15** | 33.069 | 21.772 | **48** | 105.82 | 36.741 | **81** | 178.57 |
| 7.257 | **16** | 35.274 | 22.226 | **49** | 108.03 | 37.195 | **82** | 180.78 |
| 7.711 | **17** | 37.479 | 22.680 | **50** | 110.23 | 37.648 | **83** | 182.98 |
| 8.165 | **18** | 39.683 | 23.133 | **51** | 112.44 | 38.102 | **84** | 185.19 |
| 8.618 | **19** | 41.888 | 23.587 | **52** | 114.64 | 38.555 | **85** | 187.39 |
| 9.072 | **20** | 44.092 | 24.040 | **53** | 116.84 | 39.009 | **86** | 189.60 |
| 9.525 | **21** | 46.297 | 24.494 | **54** | 119.05 | 39.463 | **87** | 191.80 |
| 9.979 | **22** | 48.502 | 24.948 | **55** | 121.25 | 39.916 | **88** | 194.01 |
| 10.433 | **23** | 50.706 | 25.401 | **56** | 123.46 | 40.370 | **89** | 196.21 |
| 10.886 | **24** | 52.911 | 25.855 | **57** | 125.66 | 40.823 | **90** | 198.42 |
| 11.340 | **25** | 55.116 | 26.308 | **58** | 127.87 | 41.277 | **91** | 200.62 |
| 11.793 | **26** | 57.320 | 26.762 | **59** | 130.07 | 41.730 | **92** | 202.83 |
| 12.247 | **27** | 59.525 | 27.216 | **60** | 132.28 | 42.184 | **93** | 205.03 |
| 12.701 | **28** | 61.729 | 27.669 | **61** | 134.48 | 42.638 | **94** | 207.23 |
| 13.154 | **29** | 63.934 | 28.123 | **62** | 136.69 | 43.091 | **95** | 209.44 |
| 13.608 | **30** | 66.139 | 28.576 | **63** | 138.89 | 43.545 | **96** | 211.64 |
| 14.061 | **31** | 68.343 | 29.030 | **64** | 141.10 | 43.998 | **97** | 213.85 |
| 14.515 | **32** | 70.548 | 29.484 | **65** | 143.30 | 44.452 | **98** | 216.05 |
| 14.969 | **33** | 72.753 | 29.937 | **66** | 145.51 | 44.906 | **99** | 218.26 |

## Appendix Table 4 °C - °F Temperature Conversion Table

**[Method of using this table]** For example, to convert 38 °C into °F, read the figure in the right °F column adjacent to the 38 in the center column in the 2nd block. This means that 38 °C is 100.4 °F. To convert 38 °F into °C, read the figure in the left °C column of the same row, which indicates that the answer is 3.3 °C.

$$C = \frac{5}{9}(F-32)$$

$$F = 32+\frac{9}{5}C$$

| °C | | °F | °C | | °F | °C | | °F | °C | | °F |
|---|---|---|---|---|---|---|---|---|---|---|---|
| -73.3 | -100 | -148.0 | 0.0 | **32** | 89.6 | 21.7 | **71** | 159.8 | 43.3 | **110** | 230 |
| -62.2 | -80 | -112.0 | 0.6 | **33** | 91.4 | 22.2 | **72** | 161.6 | 46.1 | **115** | 239 |
| -51.1 | -60 | -76.0 | 1.1 | **34** | 93.2 | 22.8 | **73** | 163.4 | 48.9 | **120** | 248 |
| -40.0 | -40 | -40.0 | 1.7 | **35** | 95.0 | 23.3 | **74** | 165.2 | 51.7 | **125** | 257 |
| -34.4 | -30 | -22.0 | 2.2 | **36** | 96.8 | 23.9 | **75** | 167.0 | 54.4 | **130** | 266 |
| -28.9 | -20 | -4.0 | 2.8 | **37** | 98.6 | 24.4 | **76** | 168.8 | 57.2 | **135** | 275 |
| -23.3 | -10 | 14.0 | 3.3 | **38** | 100.4 | 25.0 | **77** | 170.6 | 60.0 | **140** | 284 |
| -17.8 | 0 | 32.0 | 3.9 | **39** | 102.2 | 25.6 | **78** | 172.4 | 65.6 | **150** | 302 |
| -17.2 | 1 | 33.8 | 4.4 | **40** | 104.0 | 26.1 | **79** | 174.2 | 71.1 | **160** | 320 |
| -16.7 | 2 | 35.6 | 5.0 | **41** | 105.8 | 26.7 | **80** | 176.0 | 76.7 | **170** | 338 |
| -16.1 | 3 | 37.4 | 5.6 | **42** | 107.6 | 27.2 | **81** | 177.8 | 82.2 | **180** | 356 |
| -15.6 | 4 | 39.2 | 6.1 | **43** | 109.4 | 27.8 | **82** | 179.6 | 87.8 | **190** | 374 |
| -15.0 | 5 | 41.0 | 6.7 | **44** | 111.2 | 28.3 | **83** | 181.4 | 93.3 | **200** | 392 |
| -14.4 | 6 | 42.8 | 7.2 | **45** | 113.0 | 28.9 | **84** | 183.2 | 98.9 | **210** | 410 |
| -13.9 | 7 | 44.6 | 7.8 | **46** | 114.8 | 29.4 | **85** | 185.0 | 104.4 | **220** | 428 |
| -13.3 | 8 | 46.4 | 8.3 | **47** | 116.6 | 30.0 | **86** | 186.8 | 110.0 | **230** | 446 |
| -12.8 | 9 | 48.2 | 8.9 | **48** | 118.4 | 30.6 | **87** | 188.6 | 115.6 | **240** | 464 |
| -12.2 | 10 | 50.0 | 9.4 | **49** | 120.2 | 31.1 | **88** | 190.4 | 121.1 | **250** | 482 |
| -11.7 | 11 | 51.8 | 10.0 | **50** | 122.0 | 31.7 | **89** | 192.2 | 148.9 | **300** | 572 |
| -11.1 | 12 | 53.6 | 10.6 | **51** | 123.8 | 32.2 | **90** | 194.0 | 176.7 | **350** | 662 |
| -10.6 | 13 | 55.4 | 11.1 | **52** | 125.6 | 32.8 | **91** | 195.8 | 204 | **400** | 752 |
| -10.0 | 14 | 57.2 | 11.7 | **53** | 127.4 | 33.3 | **92** | 197.6 | 232 | **450** | 842 |
| -9.4 | 15 | 59.0 | 12.2 | **54** | 129.2 | 33.9 | **93** | 199.4 | 260 | **500** | 932 |
| -8.9 | 16 | 60.8 | 12.8 | **55** | 131.0 | 34.4 | **94** | 201.2 | 288 | **550** | 1022 |
| -8.3 | 17 | 62.6 | 13.3 | **56** | 132.8 | 35.0 | **95** | 203.0 | 316 | **600** | 1112 |
| -7.8 | 18 | 64.4 | 13.9 | **57** | 134.6 | 35.6 | **96** | 204.8 | 343 | **650** | 1202 |
| -7.2 | 19 | 66.2 | 14.4 | **58** | 136.4 | 36.1 | **97** | 206.6 | 371 | **700** | 1292 |
| -6.7 | 20 | 68.0 | 15.0 | **59** | 138.2 | 36.7 | **98** | 208.4 | 399 | **750** | 1382 |
| -6.1 | 21 | 69.8 | 15.6 | **60** | 140.0 | 37.2 | **99** | 210.2 | 427 | **800** | 1472 |
| -5.6 | 22 | 71.6 | 16.1 | **61** | 141.8 | 37.8 | **100** | 212.0 | 454 | **850** | 1562 |
| -5.0 | 23 | 73.4 | 16.7 | **62** | 143.6 | 38.3 | **101** | 213.8 | 482 | **900** | 1652 |
| -4.4 | 24 | 75.2 | 17.2 | **63** | 145.4 | 38.9 | **102** | 215.6 | 510 | **950** | 1742 |
| -3.9 | 25 | 77.0 | 17.8 | **64** | 147.2 | 39.4 | **103** | 217.4 | 538 | **1000** | 1832 |
| -3.3 | 26 | 78.8 | 18.3 | **65** | 149.0 | 40.0 | **104** | 219.2 | 593 | **1100** | 2012 |
| -2.8 | 27 | 80.6 | 18.9 | **66** | 150.8 | 40.6 | **105** | 221.0 | 649 | **1200** | 2192 |
| -2.2 | 28 | 82.4 | 19.4 | **67** | 152.6 | 41.1 | **106** | 222.8 | 704 | **1300** | 2372 |
| -1.7 | 29 | 84.2 | 20.0 | **68** | 154.4 | 41.7 | **107** | 224.6 | 760 | **1400** | 2552 |
| -1.1 | 30 | 86.0 | 20.6 | **69** | 156.2 | 42.2 | **108** | 226.4 | 816 | **1500** | 2732 |
| -0.6 | 31 | 87.8 | 21.1 | **70** | 158.0 | 42.8 | **109** | 228.2 | 871 | **1600** | 2912 |

## Appendix Table 5 Viscosity Conversion Table

| Kinematic Viscosity mm²/s | Saybolt Universal SUS (sec) | | No.1 Type Redwood R (sec) | | Engler E (degree) |
|---|---|---|---|---|---|
| | 100 °F | 210 °F | 50 °C | 100 °C | |
| 2 | 32.6 | 32.8 | 30.8 | 31.2 | 1.14 |
| 3 | 36.0 | 36.3 | 33.3 | 33.7 | 1.22 |
| 4 | 39.1 | 39.4 | 35.9 | 36.5 | 1.31 |
| 5 | 42.3 | 42.6 | 38.5 | 39.1 | 1.40 |
| 6 | 45.5 | 45.8 | 41.1 | 41.7 | 1.48 |
| 7 | 48.7 | 49.0 | 43.7 | 44.3 | 1.56 |
| 8 | 52.0 | 52.4 | 46.3 | 47.0 | 1.65 |
| 9 | 55.4 | 55.8 | 49.1 | 50.0 | 1.75 |
| 10 | 58.8 | 59.2 | 52.1 | 52.9 | 1.84 |
| 11 | 62.3 | 62.7 | 55.1 | 56.0 | 1.93 |
| 12 | 65.9 | 66.4 | 58.2 | 59.1 | 2.02 |
| 13 | 69.6 | 70.1 | 61.4 | 62.3 | 2.12 |
| 14 | 73.4 | 73.9 | 64.7 | 65.6 | 2.22 |
| 15 | 77.2 | 77.7 | 68.0 | 69.1 | 2.32 |
| 16 | 81.1 | 81.7 | 71.5 | 72.6 | 2.43 |
| 17 | 85.1 | 85.7 | 75.0 | 76.1 | 2.54 |
| 18 | 89.2 | 89.8 | 78.6 | 79.7 | 2.64 |
| 19 | 93.3 | 94.0 | 82.1 | 83.6 | 2.76 |
| 20 | 97.5 | 98.2 | 85.8 | 87.4 | 2.87 |
| 21 | 102 | 102 | 89.5 | 91.3 | 2.98 |
| 22 | 106 | 107 | 93.3 | 95.1 | 3.10 |
| 23 | 110 | 111 | 97.1 | 98.9 | 3.22 |
| 24 | 115 | 115 | 101 | 103 | 3.34 |
| 25 | 119 | 120 | 105 | 107 | 3.46 |
| 26 | 123 | 124 | 109 | 111 | 3.58 |
| 27 | 128 | 129 | 112 | 115 | 3.70 |
| 28 | 132 | 133 | 116 | 119 | 3.82 |
| 29 | 137 | 138 | 120 | 123 | 3.95 |
| 30 | 141 | 142 | 124 | 127 | 4.07 |
| 31 | 145 | 146 | 128 | 131 | 4.20 |
| 32 | 150 | 150 | 132 | 135 | 4.32 |
| 33 | 154 | 155 | 136 | 139 | 4.45 |
| 34 | 159 | 160 | 140 | 143 | 4.57 |

| Kinematic Viscosity mm²/s | Saybolt Universal SUS (sec) | | No.1 Type Redwood R (sec) | | Engler E (degree) |
|---|---|---|---|---|---|
| | 100 °F | 210 °F | 50 °C | 100 °C | |
| 35 | 163 | 164 | 144 | 147 | 4.70 |
| 36 | 168 | 170 | 148 | 151 | 4.83 |
| 37 | 172 | 173 | 153 | 155 | 4.96 |
| 38 | 177 | 178 | 156 | 159 | 5.08 |
| 39 | 181 | 183 | 160 | 164 | 5.21 |
| 40 | 186 | 187 | 164 | 168 | 5.34 |
| 41 | 190 | 192 | 168 | 172 | 5.47 |
| 42 | 195 | 196 | 172 | 176 | 5.59 |
| 43 | 199 | 201 | 176 | 180 | 5.72 |
| 44 | 204 | 205 | 180 | 185 | 5.85 |
| 45 | 208 | 210 | 184 | 189 | 5.98 |
| 46 | 213 | 215 | 188 | 193 | 6.11 |
| 47 | 218 | 219 | 193 | 197 | 6.24 |
| 48 | 222 | 224 | 197 | 202 | 6.37 |
| 49 | 227 | 228 | 201 | 206 | 6.50 |
| 50 | 231 | 233 | 205 | 210 | 6.63 |
| 55 | 254 | 256 | 225 | 231 | 7.24 |
| 60 | 277 | 279 | 245 | 252 | 7.90 |
| 65 | 300 | 302 | 266 | 273 | 8.55 |
| 70 | 323 | 326 | 286 | 294 | 9.21 |
| 75 | 346 | 349 | 306 | 315 | 9.89 |
| 80 | 371 | 373 | 326 | 336 | 10.5 |
| 85 | 394 | 397 | 347 | 357 | 11.2 |
| 90 | 417 | 420 | 367 | 378 | 11.8 |
| 95 | 440 | 443 | 387 | 399 | 12.5 |
| 100 | 464 | 467 | 408 | 420 | 13.2 |
| 120 | 556 | 560 | 490 | 504 | 15.8 |
| 140 | 649 | 653 | 571 | 588 | 18.4 |
| 160 | 742 | 747 | 653 | 672 | 21.1 |
| 180 | 834 | 840 | 734 | 757 | 23.7 |
| 200 | 927 | 933 | 816 | 841 | 26.3 |
| 250 | 1159 | 1167 | 1020 | 1051 | 32.9 |
| 300 | 1391 | 1400 | 1224 | 1241 | 39.5 |

Remark 1 mm²/s = 1 cSt

## Appendix Table 6 inch - mm Conversion Table

1″ = 25.4mm

| inch | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction | Decimal | mm | | | | | | | | | | |
| **0** | **0.000000** | **0.000** | **25.400** | **50.800** | **76.200** | **101.600** | **127.000** | **152.400** | **177.800** | **203.200** | **228.600** | **254.000** |
| 1/64 | 0.015625 | 0.397 | 25.797 | 51.197 | 76.597 | 101.997 | 127.397 | 152.797 | 178.197 | 203.597 | 228.997 | 254.397 |
| 1/32 | 0.031250 | 0.794 | 26.194 | 51.594 | 76.994 | 102.394 | 127.794 | 153.194 | 178.594 | 203.994 | 229.394 | 254.794 |
| 3/64 | 0.046875 | 1.191 | 26.591 | 51.991 | 77.391 | 102.791 | 128.191 | 153.591 | 178.991 | 204.391 | 229.791 | 255.191 |
| **1/16** | **0.062500** | **1.588** | **26.988** | **52.388** | **77.788** | **103.188** | **128.588** | **153.988** | **179.388** | **204.788** | **230.188** | **255.588** |
| 5/64 | 0.078125 | 1.984 | 27.384 | 52.784 | 78.184 | 103.584 | 128.984 | 154.384 | 179.784 | 205.184 | 230.584 | 255.984 |
| 3/32 | 0.093750 | 2.381 | 27.781 | 53.181 | 78.581 | 103.981 | 129.381 | 154.781 | 180.181 | 205.581 | 230.981 | 256.381 |
| 7/64 | 0.109375 | 2.778 | 28.178 | 53.578 | 78.978 | 104.378 | 129.778 | 155.178 | 180.578 | 205.978 | 231.378 | 256.778 |
| **1/8** | **0.125000** | **3.175** | **28.575** | **53.975** | **79.375** | **104.775** | **130.175** | **155.575** | **180.975** | **206.375** | **231.775** | **257.175** |
| 9/64 | 0.140625 | 3.572 | 28.972 | 54.372 | 79.772 | 105.172 | 130.572 | 155.972 | 181.372 | 206.772 | 232.172 | 257.572 |
| 5/32 | 0.156250 | 3.969 | 29.369 | 54.769 | 80.169 | 105.569 | 130.969 | 156.369 | 181.769 | 207.169 | 232.569 | 257.969 |
| 11/64 | 0.171875 | 4.366 | 29.766 | 55.166 | 80.566 | 105.966 | 131.366 | 156.766 | 182.166 | 207.566 | 232.966 | 258.366 |
| **3/16** | **0.187500** | **4.762** | **30.162** | **55.562** | **80.962** | **106.362** | **131.762** | **157.162** | **182.562** | **207.962** | **233.362** | **258.762** |
| 13/64 | 0.203125 | 5.159 | 30.559 | 55.959 | 81.359 | 106.759 | 132.159 | 157.559 | 182.959 | 208.359 | 233.759 | 259.159 |
| 7/32 | 0.218750 | 5.556 | 30.956 | 56.356 | 81.756 | 107.156 | 132.556 | 157.956 | 183.356 | 208.756 | 234.156 | 259.556 |
| 15/64 | 0.234375 | 5.953 | 31.353 | 56.753 | 82.153 | 107.553 | 132.953 | 158.353 | 183.753 | 209.153 | 234.553 | 259.953 |
| **1/4** | **0.250000** | **6.350** | **31.750** | **57.150** | **82.550** | **107.950** | **133.350** | **158.750** | **184.150** | **209.550** | **234.950** | **260.350** |
| 17/64 | 0.265625 | 6.747 | 32.147 | 57.547 | 82.947 | 108.347 | 133.747 | 159.147 | 184.547 | 209.947 | 235.347 | 260.747 |
| 9/32 | 0.281250 | 7.144 | 32.544 | 57.944 | 83.344 | 108.744 | 134.144 | 159.544 | 184.944 | 210.344 | 235.744 | 261.144 |
| 19/64 | 0.296875 | 7.541 | 32.941 | 58.341 | 83.741 | 109.141 | 134.541 | 159.941 | 185.341 | 210.741 | 236.141 | 261.541 |
| **5/16** | **0.312500** | **7.938** | **33.338** | **58.738** | **84.138** | **109.538** | **134.938** | **160.338** | **185.738** | **211.138** | **236.538** | **261.938** |
| 21/64 | 0.328125 | 8.334 | 33.734 | 59.134 | 84.534 | 109.934 | 135.334 | 160.734 | 186.134 | 211.534 | 236.934 | 262.334 |
| 11/32 | 0.343750 | 8.731 | 34.131 | 59.531 | 84.931 | 110.331 | 135.731 | 161.131 | 186.531 | 211.931 | 237.331 | 262.731 |
| 23/64 | 0.359375 | 9.128 | 34.528 | 59.928 | 85.328 | 110.728 | 136.128 | 161.528 | 186.928 | 212.328 | 237.728 | 263.128 |
| **3/8** | **0.375000** | **9.525** | **34.925** | **60.325** | **85.725** | **111.125** | **136.525** | **161.925** | **187.325** | **212.725** | **238.125** | **263.525** |
| 25/64 | 0.390625 | 9.922 | 35.322 | 60.722 | 86.122 | 111.522 | 136.922 | 162.322 | 187.722 | 213.122 | 238.522 | 263.922 |
| 13/32 | 0.406250 | 10.319 | 35.719 | 61.119 | 86.519 | 111.919 | 137.319 | 162.719 | 188.119 | 213.519 | 238.919 | 264.319 |
| 27/64 | 0.421875 | 10.716 | 36.116 | 61.516 | 86.916 | 112.316 | 137.716 | 163.116 | 188.516 | 213.916 | 239.316 | 264.716 |
| **7/16** | **0.437500** | **11.112** | **36.512** | **61.912** | **87.312** | **112.712** | **138.112** | **163.512** | **188.912** | **214.312** | **239.712** | **265.112** |
| 29/64 | 0.453125 | 11.509 | 36.909 | 62.309 | 87.709 | 113.109 | 138.509 | 163.909 | 189.309 | 214.709 | 240.109 | 265.509 |
| 15/32 | 0.468750 | 11.906 | 37.306 | 62.706 | 88.106 | 113.506 | 138.906 | 164.306 | 189.706 | 215.106 | 240.506 | 265.906 |
| 31/64 | 0.484375 | 12.303 | 37.703 | 63.103 | 88.503 | 113.903 | 139.303 | 164.703 | 190.103 | 215.503 | 240.903 | 266.303 |
| **1/2** | **0.500000** | **12.700** | **38.100** | **63.500** | **88.900** | **114.300** | **139.700** | **165.100** | **190.500** | **215.900** | **241.300** | **266.700** |
| 33/64 | 0.515625 | 13.097 | 38.497 | 63.897 | 89.297 | 114.697 | 140.097 | 165.497 | 190.897 | 216.297 | 241.697 | 267.097 |
| 17/32 | 0.531250 | 13.494 | 38.894 | 64.294 | 89.694 | 115.094 | 140.494 | 165.894 | 191.294 | 216.694 | 242.094 | 267.494 |
| 35/64 | 0.546875 | 13.891 | 39.291 | 64.691 | 90.091 | 115.491 | 140.891 | 166.291 | 191.691 | 217.091 | 242.491 | 267.891 |
| **9/16** | **0.562500** | **14.288** | **39.688** | **65.088** | **90.488** | **115.888** | **141.288** | **166.688** | **192.088** | **217.488** | **242.888** | **268.288** |
| 37/64 | 0.578125 | 14.684 | 40.084 | 65.484 | 90.884 | 116.284 | 141.684 | 167.084 | 192.484 | 217.884 | 243.284 | 268.684 |
| 19/32 | 0.593750 | 15.081 | 40.481 | 65.881 | 91.281 | 116.681 | 142.081 | 167.481 | 192.881 | 218.281 | 243.681 | 269.081 |
| 39/64 | 0.609375 | 15.478 | 40.878 | 66.278 | 91.678 | 117.078 | 142.478 | 167.878 | 193.278 | 218.678 | 244.078 | 269.478 |
| **5/8** | **0.625000** | **15.875** | **41.275** | **66.675** | **92.075** | **117.475** | **142.875** | **168.275** | **193.675** | **219.075** | **244.475** | **269.875** |
| 41/64 | 0.640625 | 16.272 | 41.672 | 67.072 | 92.472 | 117.872 | 143.272 | 168.672 | 194.072 | 219.472 | 244.872 | 270.272 |
| 21/32 | 0.656250 | 16.669 | 42.069 | 67.469 | 92.869 | 118.269 | 143.669 | 169.069 | 194.469 | 219.869 | 245.269 | 270.669 |
| 43/64 | 0.671875 | 17.066 | 42.466 | 67.866 | 93.266 | 118.666 | 144.066 | 169.466 | 194.866 | 220.266 | 245.666 | 271.066 |
| **11/16** | **0.687500** | **17.462** | **42.862** | **68.262** | **93.662** | **119.062** | **144.462** | **169.862** | **195.262** | **220.662** | **246.062** | **271.462** |
| 45/64 | 0.703125 | 17.859 | 43.259 | 68.659 | 94.059 | 119.459 | 144.859 | 170.259 | 195.659 | 221.059 | 246.459 | 271.859 |
| 23/32 | 0.718750 | 18.256 | 43.656 | 69.056 | 94.456 | 119.856 | 145.256 | 170.656 | 196.056 | 221.456 | 246.856 | 272.256 |
| 47/64 | 0.734375 | 18.653 | 44.053 | 69.453 | 94.853 | 120.253 | 145.653 | 171.053 | 196.453 | 221.853 | 247.253 | 272.653 |
| **3/4** | **0.750000** | **19.050** | **44.450** | **69.850** | **95.250** | **120.650** | **146.050** | **171.450** | **196.850** | **222.250** | **247.650** | **273.050** |
| 49/64 | 0.765625 | 19.447 | 44.847 | 70.247 | 95.647 | 121.047 | 146.447 | 171.847 | 197.247 | 222.647 | 248.047 | 273.447 |
| 25/32 | 0.781250 | 19.844 | 45.244 | 70.644 | 96.044 | 121.444 | 146.844 | 172.244 | 197.644 | 223.044 | 248.444 | 273.844 |
| 51/64 | 0.796875 | 20.241 | 45.641 | 71.041 | 96.441 | 121.841 | 147.241 | 172.641 | 198.041 | 223.441 | 248.841 | 274.241 |
| **13/16** | **0.812500** | **20.638** | **46.038** | **71.438** | **96.838** | **122.238** | **147.638** | **173.038** | **198.438** | **223.838** | **249.238** | **274.638** |
| 53/64 | 0.828125 | 21.034 | 46.434 | 71.834 | 97.234 | 122.634 | 148.034 | 173.434 | 198.834 | 224.234 | 249.634 | 275.034 |
| 27/32 | 0.843750 | 21.431 | 46.831 | 72.231 | 97.631 | 123.031 | 148.431 | 173.831 | 199.231 | 224.631 | 250.031 | 275.431 |
| 55/64 | 0.859375 | 21.828 | 47.228 | 72.628 | 98.028 | 123.428 | 148.828 | 174.228 | 199.628 | 225.028 | 250.428 | 275.828 |
| **7/8** | **0.875000** | **22.225** | **47.625** | **73.025** | **98.425** | **123.825** | **149.225** | **174.625** | **200.025** | **225.425** | **250.825** | **276.225** |
| 57/64 | 0.890625 | 22.622 | 48.022 | 73.422 | 98.822 | 124.222 | 149.622 | 175.022 | 200.422 | 225.822 | 251.222 | 276.622 |
| 29/32 | 0.906250 | 23.019 | 48.419 | 73.819 | 99.219 | 124.619 | 150.019 | 175.419 | 200.819 | 226.219 | 251.619 | 277.019 |
| 59/64 | 0.921875 | 23.416 | 48.816 | 74.216 | 99.616 | 125.016 | 150.416 | 175.816 | 201.216 | 226.616 | 252.016 | 277.416 |
| **15/16** | **0.937500** | **23.812** | **49.212** | **74.612** | **100.012** | **125.412** | **150.812** | **176.212** | **201.612** | **227.012** | **252.412** | **277.812** |
| 61/64 | 0.953125 | 24.209 | 49.609 | 75.009 | 100.409 | 125.809 | 151.209 | 176.609 | 202.009 | 227.409 | 252.809 | 278.209 |
| 31/32 | 0.968750 | 24.606 | 50.006 | 75.406 | 100.806 | 126.206 | 151.606 | 177.006 | 202.406 | 227.806 | 253.206 | 278.606 |
| 63/64 | 0.984375 | 25.003 | 50.403 | 75.803 | 101.203 | 126.603 | 152.003 | 177.403 | 202.803 | 228.203 | 253.603 | 279.003 |

1″ = 25.4mm

| inch | | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction | Decimal | mm | | | | | | | | | |
| **0** | **0.0000** | **279.400** | **304.800** | **330.200** | **355.600** | **381.000** | **406.400** | **431.800** | **457.200** | **482.600** | **508.000** |
| 1/16 | 0.0625 | 280.988 | 306.388 | 331.788 | 357.188 | 382.588 | 407.988 | 433.388 | 458.788 | 484.188 | 509.588 |
| 1/8 | 0.1250 | 282.575 | 307.975 | 333.375 | 358.775 | 384.175 | 409.575 | 434.975 | 460.375 | 485.775 | 511.175 |
| 3/16 | 0.1875 | 284.162 | 309.562 | 334.962 | 360.362 | 385.762 | 411.162 | 436.562 | 461.962 | 487.362 | 512.762 |
| **1/4** | **0.2500** | **285.750** | **311.150** | **336.550** | **361.950** | **387.350** | **412.750** | **438.150** | **463.550** | **488.950** | **514.350** |
| 5/16 | 0.3125 | 287.338 | 312.738 | 338.138 | 363.538 | 388.938 | 414.338 | 439.738 | 465.138 | 490.538 | 515.938 |
| 3/8 | 0.3750 | 288.925 | 314.325 | 339.725 | 365.125 | 390.525 | 415.925 | 441.325 | 466.725 | 492.125 | 517.525 |
| 7/16 | 0.4375 | 290.512 | 315.912 | 341.312 | 366.712 | 392.112 | 417.512 | 442.912 | 468.312 | 493.712 | 519.112 |
| **1/2** | **0.5000** | **292.100** | **317.500** | **342.900** | **368.300** | **393.700** | **419.100** | **444.500** | **469.900** | **495.300** | **520.700** |
| 9/16 | 0.5625 | 293.688 | 319.088 | 344.488 | 369.888 | 395.288 | 420.688 | 446.088 | 471.488 | 496.888 | 522.288 |
| 5/8 | 0.6250 | 295.275 | 320.675 | 346.075 | 371.475 | 396.875 | 422.275 | 447.675 | 473.075 | 498.475 | 523.875 |
| 11/16 | 0.6875 | 296.862 | 322.262 | 347.662 | 373.062 | 398.462 | 423.862 | 449.262 | 474.662 | 500.062 | 525.462 |
| **3/4** | **0.7500** | **298.450** | **323.850** | **349.250** | **374.650** | **400.050** | **425.450** | **450.850** | **476.250** | **501.650** | **527.050** |
| 13/16 | 0.8125 | 300.038 | 325.438 | 350.838 | 376.238 | 401.638 | 427.038 | 452.438 | 477.838 | 503.238 | 528.638 |
| 7/8 | 0.8750 | 301.625 | 327.025 | 352.425 | 377.825 | 403.225 | 428.625 | 454.025 | 479.425 | 504.825 | 530.225 |
| 15/16 | 0.9375 | 303.212 | 328.612 | 354.012 | 379.412 | 404.812 | 430.212 | 455.612 | 481.012 | 506.412 | 531.812 |

1″ = 25.4mm

| inch | | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction | Decimal | mm | | | | | | | | | |
| **0** | **0.0000** | **533.400** | **558.800** | **584.200** | **609.600** | **635.000** | **660.400** | **685.800** | **711.200** | **736.600** | **762.000** |
| 1/16 | 0.0625 | 534.988 | 560.388 | 585.788 | 611.188 | 636.588 | 661.988 | 687.388 | 712.788 | 738.188 | 763.588 |
| 1/8 | 0.1250 | 536.575 | 561.975 | 587.375 | 612.775 | 638.175 | 663.575 | 688.975 | 714.375 | 739.775 | 765.175 |
| 3/16 | 0.1875 | 538.162 | 563.562 | 588.962 | 614.362 | 639.762 | 665.162 | 690.562 | 715.962 | 741.362 | 766.762 |
| **1/4** | **0.2500** | **539.750** | **565.150** | **590.550** | **615.950** | **641.350** | **666.750** | **692.150** | **717.550** | **742.950** | **768.350** |
| 5/16 | 0.3125 | 541.338 | 566.738 | 592.138 | 617.538 | 642.938 | 668.338 | 693.738 | 719.138 | 744.538 | 769.938 |
| 3/8 | 0.3750 | 542.925 | 568.325 | 593.725 | 619.125 | 644.525 | 669.925 | 695.325 | 720.725 | 746.125 | 771.525 |
| 7/16 | 0.4375 | 544.512 | 569.912 | 595.312 | 620.712 | 646.112 | 671.512 | 696.912 | 722.312 | 747.712 | 773.112 |
| **1/2** | **0.5000** | **546.100** | **571.500** | **596.900** | **622.300** | **647.700** | **673.100** | **698.500** | **723.900** | **749.300** | **774.700** |
| 9/16 | 0.5625 | 547.688 | 573.088 | 598.488 | 623.888 | 649.288 | 674.688 | 700.088 | 725.488 | 750.888 | 776.288 |
| 5/8 | 0.6250 | 549.275 | 574.675 | 600.075 | 625.475 | 650.875 | 676.275 | 701.675 | 727.075 | 752.475 | 777.875 |
| 11/16 | 0.6875 | 550.862 | 576.262 | 601.662 | 627.062 | 652.462 | 677.862 | 703.262 | 728.662 | 754.062 | 779.462 |
| **3/4** | **0.7500** | **552.450** | **577.850** | **603.250** | **628.650** | **654.050** | **679.450** | **704.850** | **730.250** | **755.650** | **781.050** |
| 13/16 | 0.8125 | 554.038 | 579.438 | 604.838 | 630.238 | 655.638 | 681.038 | 706.438 | 731.838 | 757.238 | 782.638 |
| 7/8 | 0.8750 | 555.625 | 581.025 | 606.425 | 631.825 | 657.225 | 682.625 | 708.025 | 733.425 | 758.825 | 784.225 |
| 15/16 | 0.9375 | 557.212 | 582.612 | 608.012 | 633.412 | 658.812 | 684.212 | 709.612 | 735.012 | 760.412 | 785.812 |

1″=25.4mm

| inch | | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction | Decimal | mm | | | | | | | | | |
| **0** | **0.0000** | **787.400** | **812.800** | **838.200** | **863.600** | **889.000** | **914.400** | **939.800** | **965.200** | **990.600** | **1016.000** |
| 1/16 | 0.0625 | 788.988 | 814.388 | 839.788 | 865.188 | 890.588 | 915.988 | 941.388 | 966.788 | 992.188 | 1017.588 |
| 1/8 | 0.1250 | 790.575 | 815.975 | 841.375 | 866.775 | 892.175 | 917.575 | 942.975 | 968.375 | 993.775 | 1019.175 |
| 3/16 | 0.1875 | 792.162 | 817.562 | 842.962 | 868.362 | 893.762 | 919.162 | 944.562 | 969.962 | 995.362 | 1020.762 |
| **1/4** | **0.2500** | **793.750** | **819.150** | **844.550** | **869.950** | **895.350** | **920.750** | **946.150** | **971.550** | **996.950** | **1022.350** |
| 5/16 | 0.3125 | 795.338 | 820.738 | 846.138 | 871.538 | 896.938 | 922.338 | 947.738 | 973.138 | 998.538 | 1023.938 |
| 3/8 | 0.3750 | 796.925 | 822.325 | 847.725 | 873.125 | 898.525 | 923.925 | 949.325 | 974.725 | 1000.125 | 1025.525 |
| 7/16 | 0.4375 | 798.512 | 823.912 | 849.312 | 874.712 | 900.112 | 925.512 | 950.912 | 976.312 | 1001.712 | 1027.112 |
| **1/2** | **0.5000** | **800.100** | **825.500** | **850.900** | **876.300** | **901.700** | **927.100** | **952.500** | **977.900** | **1003.300** | **1028.700** |
| 9/16 | 0.5625 | 801.688 | 827.088 | 852.488 | 877.888 | 903.288 | 928.688 | 954.088 | 979.488 | 1004.888 | 1030.288 |
| 5/8 | 0.6250 | 803.275 | 828.675 | 854.075 | 879.475 | 904.875 | 930.275 | 955.675 | 981.075 | 1006.475 | 1031.875 |
| 11/16 | 0.6875 | 804.862 | 830.262 | 855.662 | 881.062 | 906.462 | 931.862 | 957.262 | 982.662 | 1008.062 | 1033.462 |
| **3/4** | **0.7500** | **806.450** | **831.850** | **857.250** | **882.650** | **908.050** | **933.450** | **958.850** | **984.250** | **1009.650** | **1035.050** |
| 13/16 | 0.8125 | 808.038 | 833.438 | 858.838 | 884.238 | 909.638 | 935.038 | 960.438 | 985.838 | 1011.238 | 1036.638 |
| 7/8 | 0.8750 | 809.625 | 835.025 | 860.425 | 885.825 | 911.225 | 936.625 | 962.025 | 987.425 | 1012.825 | 1038.225 |
| 15/16 | 0.9375 | 811.212 | 836.612 | 862.012 | 887.412 | 912.812 | 938.212 | 963.621 | 989.012 | 1014.412 | 1039.812 |

## Appendix Table 7 Hardness Conversion Table (Reference)

| Rockwell C Scale Hardness (1 471 N) {150 kgf} | Vickers Hardness | Brinell Hardness | | Rockwell Hardness | | Shore Hardness |
|---|---|---|---|---|---|---|
| | | | | A Scale | B Scale | |
| | | Standard Ball | Tungsten Carbide Ball | Load 588.4 N {60 kgf} Brale Indenter | Load 980.7 N {100 kgf} 1.588 mm (1/16 in) Ball | |
| **68** | 940 | – | – | 85.6 | – | 97 |
| **67** | 900 | – | – | 85.0 | – | 95 |
| **66** | 865 | – | – | 84.5 | – | 92 |
| **65** | 832 | – | 739 | 83.9 | – | 91 |
| **64** | 800 | – | 722 | 83.4 | – | 88 |
| **63** | 772 | – | 705 | 82.8 | – | 87 |
| **62** | 746 | – | 688 | 82.3 | – | 85 |
| **61** | 720 | – | 670 | 81.8 | – | 83 |
| **60** | 697 | – | 654 | 81.2 | – | 81 |
| **59** | 674 | – | 634 | 80.7 | – | 80 |
| **58** | 653 | – | 615 | 80.1 | – | 78 |
| **57** | 633 | – | 595 | 79.6 | – | 76 |
| **56** | 613 | – | 577 | 79.0 | – | 75 |
| **55** | 595 | – | 560 | 78.5 | – | 74 |
| **54** | 577 | – | 543 | 78.0 | – | 72 |
| **53** | 560 | – | 525 | 77.4 | – | 71 |
| **52** | 544 | 500 | 512 | 76.8 | – | 69 |
| **51** | 528 | 487 | 496 | 76.3 | – | 68 |
| **50** | 513 | 475 | 481 | 75.9 | – | 67 |
| **49** | 498 | 464 | 469 | 75.2 | – | 66 |
| **48** | 484 | 451 | 455 | 74.7 | – | 64 |
| **47** | 471 | 442 | 443 | 74.1 | – | 63 |
| **46** | 458 | 432 | 432 | 73.6 | – | 62 |
| **45** | 446 | 421 | 421 | 73.1 | – | 60 |
| **44** | 434 | 409 | 409 | 72.5 | – | 58 |
| **43** | 423 | 400 | 400 | 72.0 | – | 57 |
| **42** | 412 | 390 | 390 | 71.5 | – | 56 |
| **41** | 402 | 381 | 381 | 70.9 | – | 55 |
| **40** | 392 | 371 | 371 | 70.4 | – | 54 |
| **39** | 382 | 362 | 362 | 69.9 | – | 52 |
| **38** | 372 | 353 | 353 | 69.4 | – | 51 |
| **37** | 363 | 344 | 344 | 68.9 | – | 50 |
| **36** | 354 | 336 | 336 | 68.4 | (109.0) | 49 |
| **35** | 345 | 327 | 327 | 67.9 | (108.5) | 48 |
| **34** | 336 | 319 | 319 | 67.4 | (108.0) | 47 |
| **33** | 327 | 311 | 311 | 66.8 | (107.5) | 46 |
| **32** | 318 | 301 | 301 | 66.3 | (107.0) | 44 |
| **31** | 310 | 294 | 294 | 65.8 | (106.0) | 43 |
| **30** | 302 | 286 | 286 | 65.3 | (105.5) | 42 |
| **29** | 294 | 279 | 279 | 64.7 | (104.5) | 41 |
| **28** | 286 | 271 | 271 | 64.3 | (104.0) | 41 |
| **27** | 279 | 264 | 264 | 63.8 | (103.0) | 40 |
| **26** | 272 | 258 | 258 | 63.3 | (102.5) | 38 |
| **25** | 266 | 253 | 253 | 62.8 | (101.5) | 38 |
| **24** | 260 | 247 | 247 | 62.4 | (101.0) | 37 |
| **23** | 254 | 243 | 243 | 62.0 | 100.0 | 36 |
| **22** | 248 | 237 | 237 | 61.5 | 99.0 | 35 |
| **21** | 243 | 231 | 231 | 61.0 | 98.5 | 35 |
| **20** | 238 | 226 | 226 | 60.5 | 97.8 | 34 |
| **(18)** | 230 | 219 | 219 | – | 96.7 | 33 |
| **(16)** | 222 | 212 | 212 | – | 95.5 | 32 |
| **(14)** | 213 | 203 | 203 | – | 93.9 | 31 |
| **(12)** | 204 | 194 | 194 | – | 92.3 | 29 |
| **(10)** | 196 | 187 | 187 | – | 90.7 | 28 |
| **(8)** | 188 | 179 | 179 | – | 89.5 | 27 |
| **(6)** | 180 | 171 | 171 | – | 87.1 | 26 |
| **(4)** | 173 | 165 | 165 | – | 85.5 | 25 |
| **(2)** | 166 | 158 | 158 | – | 83.5 | 24 |
| **(0)** | 160 | 152 | 152 | – | 81.7 | 24 |

## Appendix Table 8 Physical and Mechanical Properties of Materials

| Materials | Specific Gravity | Coefficient of Linear Expansion (0° to 100°C) ($K^{-1}$) | Hardness (Brinell) | Young's modulus (MPa) {kgf/mm²} | Tensile Strength (MPa) {kgf/mm²} | Yield Point (MPa) {kgf/mm²} | Elongation (%) |
|---|---|---|---|---|---|---|---|
| Bearing Steel (hardened) | 7.83 | $12.5\times10^{-6}$ | 650 to 740 | 208 000 {21 200} | 1 570 to 1 960 {160 to 200} | – | – |
| Martensitic Stainless Steel SUS 440C | 7.68 | $10.1\times10^{-6}$ | 580 | 200 000 {20 400} | 1 960 {200} | 1 860 {190} | – |
| Mild Steel (C=0.12~0.20%) | 7.86 | $11.6\times10^{-6}$ | 100 to 130 | 206 000 {21 000} | 373 to 471 {38 to 48} | 216 to 294 {22 to 30} | 24 to 36 |
| Hard Steel (C=0.3~0.5%) | 7.84 | $11.3\times10^{-6}$ | 160 to 200 | 206 000 {21 000} | 539 to 686 {55 to 70} | 333 to 451 {34 to 46} | 14 to 26 |
| Austenitic Stainless Steel SUS 304 | 8.03 | $16.3\times10^{-6}$ | 150 | 193 000 {19 700} | 588 {60} | 245 {25} | 60 |
| Cast Iron Gray Iron FC200 | 7.3 | $10.4\times10^{-6}$ | 223 | 98 100 {10 000} | More than 200 {20} | – | – |
| Cast Iron Spheroidal graphite Iron FCD400 | 7.0 | $11.7\times10^{-6}$ | Less than 201 | 169 000 {17 200} | More than 400 {41} | – | More than 12 |
| Aluminium | 2.69 | $23.7\times10^{-6}$ | 15 to 26 | 70 600 {7 200} | 78 {8} | 34 {3.5} | 35 |
| Zinc | 7.14 | $31\times10^{-6}$ | 30 to 60 | 92 200 {9 400} | 147 {15} | – | 30 to 40 |
| Copper | 8.93 | $16.2\times10^{-6}$ | 50 | 123 000 {12 500} | 196 {20} | 69 {7} | 15 to 20 |
| Brass (Annealed) | 8.5 | $19.1\times10^{-6}$ | 45 | 103 000 {10 500} | 294 to 343 {30 to 35} | – | 65 to 75 |
| Brass (Machined) | | | 85 to 130 | | 363 to 539 {37 to 55} | | 15 to 50 |

Remark The hardness of hardened bearing steel and martensitic stainless steel is usually expressed using the Rockwell C Scale. For comparison, it is converted into Brinell hardness.

## Appendix Table 9 Tolerances for Shaft Diameters

| Diameter Classification (mm) over | incl. | Single Plane Mean B.D. Deviation (Normal) $\Delta_{dmp}$ | d6 | e6 | f6 | g5 | g6 | h5 | h6 | h7 | h8 | h9 | h10 | js5 | js6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 6 | 0<br>– 8 | – 30<br>– 38 | – 20<br>– 28 | –10<br>–18 | – 4<br>– 9 | – 4<br>– 12 | 0<br>– 5 | 0<br>– 8 | 0<br>– 12 | 0<br>– 18 | 0<br>– 30 | 0<br>– 48 | ±2.5 | ±4 |
| 6 | 10 | 0<br>– 8 | – 40<br>– 49 | – 25<br>– 34 | –13<br>–22 | – 5<br>–11 | – 5<br>– 14 | 0<br>– 6 | 0<br>– 9 | 0<br>– 15 | 0<br>– 22 | 0<br>– 36 | 0<br>– 58 | ±3 | ±4.5 |
| 10 | 18 | 0<br>– 8 | – 50<br>– 61 | – 32<br>– 43 | –16<br>–27 | – 6<br>–14 | – 6<br>– 17 | 0<br>– 8 | 0<br>–11 | 0<br>– 18 | 0<br>– 27 | 0<br>– 43 | 0<br>– 70 | ±4 | ±5.5 |
| 18 | 30 | 0<br>–10 | – 65<br>– 78 | – 40<br>– 53 | –20<br>–33 | – 7<br>–16 | – 7<br>– 20 | 0<br>– 9 | 0<br>–13 | 0<br>– 21 | 0<br>– 33 | 0<br>– 52 | 0<br>– 84 | ±4.5 | ±6.5 |
| 30 | 50 | 0<br>–12 | – 80<br>– 96 | – 50<br>– 66 | –25<br>–41 | – 9<br>–20 | – 9<br>– 25 | 0<br>–11 | 0<br>–16 | 0<br>– 25 | 0<br>– 39 | 0<br>– 62 | 0<br>–100 | ±5.5 | ±8 |
| 50 | 80 | 0<br>–15 | –100<br>–119 | – 60<br>– 79 | –30<br>–49 | –10<br>–23 | – 10<br>– 29 | 0<br>–13 | 0<br>–19 | 0<br>– 30 | 0<br>– 46 | 0<br>– 74 | 0<br>–120 | ±6.5 | ±9.5 |
| 80 | 120 | 0<br>–20 | –120<br>–142 | – 72<br>– 94 | –36<br>–58 | –12<br>–27 | – 12<br>– 34 | 0<br>–15 | 0<br>–22 | 0<br>– 35 | 0<br>– 54 | 0<br>– 87 | 0<br>–140 | ±7.5 | ±11 |
| 120 | 180 | 0<br>–25 | –145<br>–170 | – 85<br>–110 | – 43<br>– 68 | –14<br>–32 | – 14<br>– 39 | 0<br>–18 | 0<br>–25 | 0<br>– 40 | 0<br>– 63 | 0<br>–100 | 0<br>–160 | ±9 | ±12.5 |
| 180 | 250 | 0<br>–30 | –170<br>–199 | –100<br>–129 | – 50<br>– 79 | –15<br>–35 | – 15<br>– 44 | 0<br>–20 | 0<br>–29 | 0<br>– 46 | 0<br>–72 | 0<br>–115 | 0<br>–185 | ±10 | ±14.5 |
| 250 | 315 | 0<br>–35 | –190<br>–222 | –110<br>–142 | – 56<br>– 88 | –17<br>–40 | – 17<br>– 49 | 0<br>–23 | 0<br>–32 | 0<br>– 52 | 0<br>– 81 | 0<br>–130 | 0<br>–210 | ±11.5 | ±16 |
| 315 | 400 | 0<br>–40 | –210<br>–246 | –125<br>–161 | – 62<br>– 98 | –18<br>–43 | – 18<br>– 54 | 0<br>–25 | 0<br>–36 | 0<br>– 57 | 0<br>– 89 | 0<br>–140 | 0<br>–230 | ±12.5 | ±18 |
| 400 | 500 | 0<br>–45 | –230<br>–270 | –135<br>–175 | – 68<br>–108 | –20<br>–47 | – 20<br>– 60 | 0<br>–27 | 0<br>–40 | 0<br>– 63 | 0<br>– 97 | 0<br>–155 | 0<br>–250 | ±13.5 | ±20 |
| 500 | 630 | 0<br>–50 | –260<br>–304 | –145<br>–189 | – 76<br>–120 | – | – 22<br>– 66 | – | 0<br>–44 | 0<br>– 70 | 0<br>–110 | 0<br>–175 | 0<br>–280 | – | ±22 |
| 630 | 800 | 0<br>–75 | –290<br>–340 | –160<br>–210 | – 80<br>–130 | – | – 24<br>– 74 | – | 0<br>–50 | 0<br>– 80 | 0<br>–125 | 0<br>–200 | 0<br>–320 | – | ±25 |
| 800 | 1 000 | 0<br>–100 | –320<br>–376 | –170<br>–226 | – 86<br>–142 | – | – 26<br>– 82 | – | 0<br>–56 | 0<br>– 90 | 0<br>–140 | 0<br>–230 | 0<br>–360 | – | ±28 |
| 1 000 | 1 250 | 0<br>–125 | –350<br>–416 | –195<br>–261 | – 98<br>–164 | – | – 28<br>– 94 | – | 0<br>–66 | 0<br>–105 | 0<br>–165 | 0<br>–260 | 0<br>–420 | – | ±33 |
| 1 250 | 1 600 | 0<br>–160 | –390<br>–468 | –220<br>–298 | –110<br>–188 | – | – 30<br>–108 | – | 0<br>–78 | 0<br>–125 | 0<br>–195 | 0<br>–310 | 0<br>–500 | – | ±39 |
| 1 600 | 2 000 | 0<br>–200 | –430<br>–522 | –240<br>–332 | –120<br>–212 | – | – 32<br>–124 | – | 0<br>–92 | 0<br>–150 | 0<br>–230 | 0<br>–370 | 0<br>–600 | – | ±46 |

Units : µm

| j5 | j6 | j7 | k5 | k6 | k7 | m5 | m6 | n6 | p6 | r6 | r7 | Diameter Classification (mm) over | Diameter Classification (mm) incl. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| + 3<br>− 2 | + 6<br>− 2 | + 8<br>− 4 | + 6<br>+ 1 | + 9<br>+ 1 | + 13<br>+ 1 | + 9<br>+ 4 | + 12<br>+ 4 | + 16<br>+ 8 | + 20<br>+ 12 | + 23<br>+ 15 | + 27<br>+ 15 | 3 | 6 |
| + 4<br>− 2 | + 7<br>− 2 | +10<br>− 5 | + 7<br>+ 1 | +10<br>+ 1 | + 16<br>+ 1 | +12<br>+ 6 | + 15<br>+ 6 | + 19<br>+ 10 | + 24<br>+ 15 | + 28<br>+ 19 | + 34<br>+ 19 | 6 | 10 |
| + 5<br>− 3 | + 8<br>− 3 | +12<br>− 6 | + 9<br>+ 1 | +12<br>+ 1 | + 19<br>+ 1 | +15<br>+ 7 | + 18<br>+ 7 | + 23<br>+ 12 | + 29<br>+ 18 | + 34<br>+ 23 | + 41<br>+ 23 | 10 | 18 |
| + 5<br>− 4 | + 9<br>− 4 | +13<br>− 8 | +11<br>+ 2 | +15<br>+ 2 | + 23<br>+ 2 | +17<br>+ 8 | + 21<br>+ 8 | + 28<br>+ 15 | + 35<br>+ 22 | + 41<br>+ 28 | + 49<br>+ 28 | 18 | 30 |
| + 6<br>− 5 | +11<br>− 5 | +15<br>−10 | +13<br>+ 2 | +18<br>+ 2 | + 27<br>+ 2 | +20<br>+ 9 | + 25<br>+ 9 | + 33<br>+ 17 | + 42<br>+ 26 | + 50<br>+ 34 | + 59<br>+ 34 | 30 | 50 |
| + 6<br>− 7 | +12<br>− 7 | +18<br>−12 | +15<br>+ 2 | +21<br>+ 2 | + 32<br>+ 2 | +24<br>+11 | + 30<br>+ 11 | + 39<br>+ 20 | + 51<br>+ 32 | + 60<br>+ 41 | + 71<br>+ 41 | 50 | 65 |
| | | | | | | | | | | + 62<br>+ 43 | + 73<br>+ 43 | 65 | 80 |
| + 6<br>− 9 | +13<br>− 9 | +20<br>−15 | +18<br>+ 3 | +25<br>+ 3 | + 38<br>+ 3 | +28<br>+13 | + 35<br>+ 13 | + 45<br>+ 23 | + 59<br>+ 37 | + 73<br>+ 51 | + 86<br>+ 51 | 80 | 100 |
| | | | | | | | | | | + 76<br>+ 54 | + 89<br>+ 54 | 100 | 120 |
| | | | | | | | | | | + 88<br>+ 63 | +103<br>+ 63 | 120 | 140 |
| + 7<br>−11 | +14<br>−11 | +22<br>−18 | +21<br>+ 3 | +28<br>+ 3 | + 43<br>+ 3 | +33<br>+15 | + 40<br>+ 15 | + 52<br>+ 27 | + 68<br>+ 43 | + 90<br>+ 65 | +105<br>+ 65 | 140 | 160 |
| | | | | | | | | | | + 93<br>+ 68 | +108<br>+ 68 | 160 | 180 |
| | | | | | | | | | | +106<br>+ 77 | +123<br>+ 77 | 180 | 200 |
| + 7<br>−13 | +16<br>−13 | +25<br>−21 | +24<br>+ 4 | +33<br>+ 4 | + 50<br>+ 4 | +37<br>+17 | + 46<br>+ 17 | + 60<br>+ 31 | + 79<br>+ 50 | +109<br>+ 80 | +126<br>+ 80 | 200 | 225 |
| | | | | | | | | | | +113<br>+ 84 | +130<br>+ 84 | 225 | 250 |
| + 7<br>−16 | ±16 | ±26 | +27<br>+ 4 | +36<br>+ 4 | + 56<br>+ 4 | +43<br>+20 | + 52<br>+ 20 | + 66<br>+ 34 | + 88<br>+ 56 | +126<br>+ 94 | +146<br>+ 94 | 250 | 280 |
| | | | | | | | | | | +130<br>+ 98 | +150<br>+ 98 | 280 | 315 |
| + 7<br>−18 | ±18 | +29<br>−28 | +29<br>+ 4 | +40<br>+ 4 | + 61<br>+ 4 | +46<br>+21 | + 57<br>+ 21 | + 73<br>+ 37 | + 98<br>+ 62 | +144<br>+108 | +165<br>+108 | 315 | 355 |
| | | | | | | | | | | +150<br>+114 | +171<br>+114 | 355 | 400 |
| + 7<br>−20 | ±20 | +31<br>−32 | +32<br>+ 5 | +45<br>+ 5 | + 68<br>+ 5 | +50<br>+23 | + 63<br>+ 23 | + 80<br>+ 40 | +108<br>+ 68 | +166<br>+126 | +189<br>+126 | 400 | 450 |
| | | | | | | | | | | +172<br>+132 | +195<br>+132 | 450 | 500 |
| – | – | – | – | +44<br>0 | + 70<br>0 | – | + 70<br>+ 26 | + 88<br>+ 44 | +122<br>+ 78 | +194<br>+150 | +220<br>+150 | 500 | 560 |
| | | | | | | | | | | +199<br>+155 | +225<br>+155 | 560 | 630 |
| – | – | – | – | +50<br>0 | + 80<br>0 | – | + 80<br>+ 30 | +100<br>+ 50 | +138<br>+ 88 | +225<br>+175 | +255<br>+175 | 630 | 710 |
| | | | | | | | | | | +235<br>+185 | +265<br>+185 | 710 | 800 |
| – | – | – | – | +56<br>0 | + 90<br>0 | – | + 90<br>+ 34 | +112<br>+ 56 | +156<br>+100 | +266<br>+210 | +300<br>+210 | 800 | 900 |
| | | | | | | | | | | +276<br>+220 | +310<br>+220 | 900 | 1 000 |
| – | – | – | – | +66<br>0 | +105<br>0 | – | +106<br>+ 40 | +132<br>+ 66 | +186<br>+120 | +316<br>+250 | +355<br>+250 | 1 000 | 1 120 |
| | | | | | | | | | | +326<br>+260 | +365<br>+260 | 1 120 | 1 250 |
| – | – | – | – | +78<br>0 | +125<br>0 | – | +126<br>+ 48 | +156<br>+ 78 | +218<br>+140 | +378<br>+300 | +425<br>+300 | 1 250 | 1 400 |
| | | | | | | | | | | +408<br>+330 | +455<br>+330 | 1 400 | 1 600 |
| – | – | – | – | +92<br>0 | +150<br>0 | – | +150<br>+ 58 | +184<br>+ 92 | +262<br>+170 | +462<br>+370 | +520<br>+370 | 1 600 | 1 800 |
| | | | | | | | | | | +492<br>+400 | +550<br>+400 | 1 800 | 2 000 |

## Appendix Table 10 Tolerances for Housing Bore Diameters

| Diameter Classification (mm) | | Single Plane Mean B.D. Deviation (Normal) $\Delta_{Dmp}$ | E6 | F6 | F7 | G6 | G7 | H6 | H7 | H8 | J6 | J7 | JS6 | JS7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| over | incl. | | | | | | | | | | | | | |
| 10 | 18 | 0<br>- 8 | + 43<br>+ 32 | + 27<br>+ 16 | + 34<br>+ 16 | + 17<br>+ 6 | + 24<br>+ 6 | + 11<br>0 | + 18<br>0 | + 27<br>0 | + 6<br>- 5 | +10<br>- 8 | ±5.5 | ±9 |
| 18 | 30 | 0<br>- 9 | + 53<br>+ 40 | + 33<br>+ 20 | + 41<br>+ 20 | + 20<br>+ 7 | + 28<br>+ 7 | + 13<br>0 | + 21<br>0 | + 33<br>0 | + 8<br>- 5 | +12<br>- 9 | ±6.5 | ±10.5 |
| 30 | 50 | 0<br>- 11 | + 66<br>+ 50 | + 41<br>+ 25 | + 50<br>+ 25 | + 25<br>+ 9 | + 34<br>+ 9 | + 16<br>0 | + 25<br>0 | + 39<br>0 | +10<br>- 6 | +14<br>-11 | ±8 | ±12.5 |
| 50 | 80 | 0<br>- 13 | + 79<br>+ 60 | + 49<br>+ 30 | + 60<br>+ 30 | + 29<br>+ 10 | + 40<br>+ 10 | + 19<br>0 | + 30<br>0 | + 46<br>0 | +13<br>- 6 | +18<br>-12 | ±9.5 | ±15 |
| 80 | 120 | 0<br>- 15 | + 94<br>+ 72 | + 58<br>+ 36 | + 71<br>+ 36 | + 34<br>+ 12 | + 47<br>+ 12 | + 22<br>0 | + 35<br>0 | + 54<br>0 | +16<br>- 6 | +22<br>-13 | ±11 | ±17.5 |
| 120<br>150 | 150<br>180 | 0<br>- 18<br>0<br>- 25 | +110<br>+ 85 | + 68<br>+ 43 | + 83<br>+ 43 | + 39<br>+ 14 | + 54<br>+ 14 | + 25<br>0 | + 40<br>0 | + 63<br>0 | +18<br>- 7 | +26<br>-14 | ±12.5 | ±20 |
| 180 | 250 | 0<br>- 30 | +129<br>+100 | + 79<br>+ 50 | + 96<br>+ 50 | + 44<br>+ 15 | + 61<br>+ 15 | + 29<br>0 | + 46<br>0 | + 72<br>0 | +22<br>- 7 | +30<br>-16 | ±14.5 | ±23 |
| 250 | 315 | 0<br>- 35 | +142<br>+110 | + 88<br>+ 56 | +108<br>+ 56 | + 49<br>+ 17 | + 69<br>+ 17 | + 32<br>0 | + 52<br>0 | + 81<br>0 | +25<br>- 7 | +36<br>-16 | ±16 | ±26 |
| 315 | 400 | 0<br>- 40 | +161<br>+125 | + 98<br>+ 62 | +119<br>+ 62 | + 54<br>+ 18 | + 75<br>+ 18 | + 36<br>0 | + 57<br>0 | + 89<br>0 | +29<br>- 7 | +39<br>-18 | ±18 | ±28.5 |
| 400 | 500 | 0<br>- 45 | +175<br>+135 | +108<br>+ 68 | +131<br>+ 68 | + 60<br>+ 20 | + 83<br>+ 20 | + 40<br>0 | + 63<br>0 | + 97<br>0 | +33<br>- 7 | +43<br>-20 | ±20 | ±31.5 |
| 500 | 630 | 0<br>- 50 | +189<br>+145 | +120<br>+ 76 | +146<br>+ 76 | + 66<br>+ 22 | + 92<br>+ 22 | + 44<br>0 | + 70<br>0 | +110<br>0 | - | - | ±22 | ±35 |
| 630 | 800 | 0<br>- 75 | +210<br>+160 | +130<br>+ 80 | +160<br>+ 80 | + 74<br>+ 24 | +104<br>+ 24 | + 50<br>0 | + 80<br>0 | +125<br>0 | - | - | ±25 | ±40 |
| 800 | 1 000 | 0<br>-100 | +226<br>+170 | +142<br>+ 86 | +176<br>+ 86 | + 82<br>+ 26 | +116<br>+ 26 | + 56<br>0 | + 90<br>0 | +140<br>0 | - | - | ±28 | ±45 |
| 1 000 | 1 250 | 0<br>-125 | +261<br>+195 | +164<br>+ 98 | +203<br>+ 98 | + 94<br>+ 28 | +133<br>+28 | + 66<br>0 | +105<br>0 | +165<br>0 | - | - | ±33 | ±52.5 |
| 1 250 | 1 600 | 0<br>-160 | +298<br>+220 | +188<br>+110 | +235<br>+110 | +108<br>+ 30 | +155<br>+ 30 | + 78<br>0 | +125<br>0 | +195<br>0 | - | - | ±39 | ±62.5 |
| 1 600 | 2 000 | 0<br>-200 | +332<br>+240 | +212<br>+120 | +270<br>+120 | +124<br>+ 32 | +182<br>+ 32 | + 92<br>0 | +150<br>0 | +230<br>0 | - | - | ±46 | ±75 |
| 2 000 | 2 500 | 0<br>-250 | +370<br>+260 | +240<br>+130 | +305<br>+130 | +144<br>+ 34 | +209<br>+ 34 | +110<br>0 | +175<br>0 | +280<br>0 | - | - | ±55 | ±87.5 |

Units : µm

| K5 | K6 | K7 | M5 | M6 | M7 | N5 | N6 | N7 | P6 | P7 | Diameter Classification (mm) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | over | incl. |
| + 2<br>- 6 | + 2<br>- 9 | + 6<br>- 12 | - 4<br>-12 | - 4<br>- 15 | 0<br>- 18 | - 9<br>-17 | - 9<br>- 20 | - 5<br>- 23 | - 15<br>- 26 | - 11<br>- 29 | 10 | 18 |
| + 1<br>- 8 | + 2<br>- 11 | + 6<br>- 15 | - 5<br>-14 | - 4<br>- 17 | 0<br>- 21 | -12<br>-21 | - 11<br>- 24 | - 7<br>- 28 | - 18<br>- 31 | -14<br>- 35 | 18 | 30 |
| + 2<br>- 9 | + 3<br>- 13 | + 7<br>- 18 | - 5<br>-16 | - 4<br>- 20 | 0<br>- 25 | -13<br>-24 | - 12<br>- 28 | - 8<br>- 33 | - 21<br>- 37 | - 17<br>- 42 | 30 | 50 |
| + 3<br>-10 | + 4<br>- 15 | + 9<br>- 21 | - 6<br>-19 | - 5<br>- 24 | 0<br>-30 | -15<br>-28 | - 14<br>- 33 | - 9<br>- 39 | - 26<br>- 45 | - 21<br>- 51 | 50 | 80 |
| + 2<br>-13 | + 4<br>- 18 | + 10<br>- 25 | - 8<br>-23 | - 6<br>- 28 | 0<br>- 35 | -18<br>-33 | - 16<br>- 38 | - 10<br>- 45 | - 30<br>- 52 | - 24<br>- 59 | 80 | 120 |
| + 3<br>-15 | + 4<br>- 21 | + 12<br>- 28 | - 9<br>-27 | - 8<br>- 33 | 0<br>- 40 | -21<br>-39 | - 20<br>- 45 | - 12<br>- 52 | - 36<br>- 61 | - 28<br>- 68 | 120 | 180 |
| + 2<br>-18 | + 5<br>- 24 | + 13<br>- 33 | -11<br>-31 | - 8<br>- 37 | 0<br>- 46 | -25<br>-45 | - 22<br>- 51 | - 14<br>- 60 | - 41<br>- 70 | - 33<br>- 79 | 180 | 250 |
| + 3<br>-20 | + 5<br>- 27 | + 16<br>- 36 | -13<br>-36 | - 9<br>- 41 | 0<br>- 52 | -27<br>-50 | - 25<br>- 57 | - 14<br>- 66 | - 47<br>- 79 | - 36<br>- 88 | 250 | 315 |
| + 3<br>-22 | + 7<br>- 29 | + 17<br>- 40 | -14<br>-39 | - 10<br>- 46 | 0<br>- 57 | -30<br>-55 | - 26<br>- 62 | - 16<br>- 73 | - 51<br>- 87 | - 41<br>- 98 | 315 | 400 |
| + 2<br>-25 | + 8<br>- 32 | + 18<br>- 45 | -16<br>-43 | - 10<br>- 50 | 0<br>- 63 | -33<br>-60 | - 27<br>- 67 | - 17<br>- 80 | - 55<br>- 95 | - 45<br>-108 | 400 | 500 |
| - | 0<br>- 44 | 0<br>- 70 | - | - 26<br>- 70 | - 26<br>- 96 | - | - 44<br>- 88 | - 44<br>-114 | - 78<br>-122 | - 78<br>-148 | 500 | 630 |
| - | 0<br>- 50 | 0<br>- 80 | - | - 30<br>- 80 | - 30<br>-110 | - | - 50<br>-100 | - 50<br>-130 | - 88<br>-138 | - 88<br>-168 | 630 | 800 |
| - | 0<br>- 56 | 0<br>- 90 | - | - 34<br>- 90 | - 34<br>-124 | - | - 56<br>-112 | - 56<br>-146 | -100<br>-156 | -100<br>-190 | 800 | 1 000 |
| - | 0<br>- 66 | 0<br>-105 | - | - 40<br>-106 | - 40<br>-145 | - | - 66<br>-132 | - 66<br>-171 | -120<br>-186 | -120<br>-225 | 1 000 | 1 250 |
| - | 0<br>- 78 | 0<br>-125 | - | - 48<br>-126 | - 48<br>-173 | - | - 78<br>-156 | - 78<br>-203 | -140<br>-218 | -140<br>-265 | 1 250 | 1 600 |
| - | 0<br>- 92 | 0<br>-150 | - | - 58<br>-150 | - 58<br>-208 | - | - 92<br>-184 | - 92<br>-242 | -170<br>-262 | -170<br>-320 | 1 600 | 2 000 |
| - | 0<br>-110 | 0<br>-175 | - | - 68<br>-178 | - 68<br>-243 | - | -110<br>-220 | -110<br>-285 | -195<br>-305 | -195<br>-370 | 2 000 | 2 500 |

## Appendix Table 11 Values of Standard Tolerance Grades IT

| Basic Size (mm) | | Standard Grades | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | IT1 | IT2 | IT3 | IT4 | IT5 | IT6 | IT7 | IT8 | IT9 | IT10 | IT11 |
| over | incl. | Tolerances (μm) | | | | | | | | | | |
| – | 3 | 0.8 | 1.2 | 2 | 3 | 4 | 6 | 10 | 14 | 25 | 40 | 60 |
| 3 | 6 | 1 | 1.5 | 2.5 | 4 | 5 | 8 | 12 | 18 | 30 | 48 | 75 |
| 6 | 10 | 1 | 1.5 | 2.5 | 4 | 6 | 9 | 15 | 22 | 36 | 58 | 90 |
| 10 | 18 | 1.2 | 2 | 3 | 5 | 8 | 11 | 18 | 27 | 43 | 70 | 110 |
| 18 | 30 | 1.5 | 2.5 | 4 | 6 | 9 | 13 | 21 | 33 | 52 | 84 | 130 |
| 30 | 50 | 1.5 | 2.5 | 4 | 7 | 11 | 16 | 25 | 39 | 62 | 100 | 160 |
| 50 | 80 | 2 | 3 | 5 | 8 | 13 | 19 | 30 | 46 | 74 | 120 | 190 |
| 80 | 120 | 2.5 | 4 | 6 | 10 | 15 | 22 | 35 | 54 | 87 | 140 | 220 |
| 120 | 180 | 3.5 | 5 | 8 | 12 | 18 | 25 | 40 | 63 | 100 | 160 | 250 |
| 180 | 250 | 4.5 | 7 | 10 | 14 | 20 | 29 | 46 | 72 | 115 | 185 | 290 |
| 250 | 315 | 6 | 8 | 12 | 16 | 23 | 32 | 52 | 81 | 130 | 210 | 320 |
| 315 | 400 | 7 | 9 | 13 | 18 | 25 | 36 | 57 | 89 | 140 | 230 | 360 |
| 400 | 500 | 8 | 10 | 15 | 20 | 27 | 40 | 63 | 97 | 155 | 250 | 400 |
| 500 | 630 | 9 | 11 | 16 | 22 | 32 | 44 | 70 | 110 | 175 | 280 | 440 |
| 630 | 800 | 10 | 13 | 18 | 25 | 36 | 50 | 80 | 125 | 200 | 320 | 500 |
| 800 | 1 000 | 11 | 15 | 21 | 28 | 40 | 56 | 90 | 140 | 230 | 360 | 560 |
| 1 000 | 1 250 | 13 | 18 | 24 | 33 | 47 | 66 | 105 | 165 | 260 | 420 | 660 |
| 1 250 | 1 600 | 15 | 21 | 29 | 39 | 55 | 78 | 125 | 195 | 310 | 500 | 780 |
| 1 600 | 2 000 | 18 | 25 | 35 | 46 | 65 | 92 | 150 | 230 | 370 | 600 | 920 |
| 2 000 | 2 500 | 22 | 30 | 41 | 55 | 78 | 110 | 175 | 280 | 440 | 700 | 1 100 |
| 2 500 | 3 150 | 26 | 36 | 50 | 68 | 96 | 135 | 210 | 330 | 540 | 860 | 1 350 |

Remarks 1. Standard tolerance grades IT14 to IT18 shall not be used for basic sizes less than or equal to 1 mm.
2. Values for standard tolerance grades IT1 to IT5 for basic sizes over 500 mm are included for experimental use.

| Standard Grades | | | | | | | Basic Size (mm) | |
|---|---|---|---|---|---|---|---|---|
| IT12 | IT13 | IT14 | IT15 | IT16 | IT17 | IT18 | | |
| Tolerances (mm) | | | | | | | over | incl. |
| 0.10 | 0.14 | 0.25 | 0.40 | 0.60 | 1.00 | 1.40 | – | 3 |
| 0.12 | 0.18 | 0.30 | 0.48 | 0.75 | 1.20 | 1.80 | 3 | 6 |
| 0.15 | 0.22 | 0.36 | 0.58 | 0.90 | 1.50 | 2.20 | 6 | 10 |
| 0.18 | 0.27 | 0.43 | 0.70 | 1.10 | 1.80 | 2.70 | 10 | 18 |
| 0.21 | 0.33 | 0.52 | 0.84 | 1.30 | 2.10 | 3.30 | 18 | 30 |
| 0.25 | 0.39 | 0.62 | 1.00 | 1.60 | 2.50 | 3.90 | 30 | 50 |
| 0.30 | 0.46 | 0.74 | 1.20 | 1.90 | 3.00 | 4.60 | 50 | 80 |
| 0.35 | 0.54 | 0.87 | 1.40 | 2.20 | 3.50 | 5.40 | 80 | 120 |
| 0.40 | 0.63 | 1.00 | 1.60 | 2.50 | 4.00 | 6.30 | 120 | 180 |
| 0.46 | 0.72 | 1.15 | 1.85 | 2.90 | 4.60 | 7.20 | 180 | 250 |
| 0.52 | 0.81 | 1.30 | 2.10 | 3.20 | 5.20 | 8.10 | 250 | 315 |
| 0.57 | 0.89 | 1.40 | 2.30 | 3.60 | 5.70 | 8.90 | 315 | 400 |
| 0.63 | 0.97 | 1.55 | 2.50 | 4.00 | 6.30 | 9.70 | 400 | 500 |
| 0.70 | 1.10 | 1.75 | 2.80 | 4.40 | 7.00 | 11.00 | 500 | 630 |
| 0.80 | 1.25 | 2.00 | 3.20 | 5.00 | 8.00 | 12.50 | 630 | 800 |
| 0.90 | 1.40 | 2.30 | 3.60 | 5.60 | 9.00 | 14.00 | 800 | 1 000 |
| 1.05 | 1.65 | 2.60 | 4.20 | 6.60 | 10.50 | 16.50 | 1 000 | 1 250 |
| 1.25 | 1.95 | 3.10 | 5.00 | 7.80 | 12.50 | 19.50 | 1 250 | 1 600 |
| 1.50 | 2.30 | 3.70 | 6.00 | 9.20 | 15.00 | 23.00 | 1 600 | 2 000 |
| 1.75 | 2.80 | 4.40 | 7.00 | 11.00 | 17.50 | 28.00 | 2 000 | 2 500 |
| 2.10 | 3.30 | 5.40 | 8.60 | 13.50 | 21.00 | 33.00 | 2 500 | 3 150 |

## Appendix Table 12 Speed Factor $f_n$

Ball Bearings $f_n = (0.03\ n)^{-1/3}$

Roller Bearings $f_n = (0.03\ n)^{-3/10}$

| Speed n (min⁻¹) | Speed Factor $f_n$ | |
|---|---|---|
| | Ball Bearings | Roller Bearings |
| **10** | 1.49 | 1.44 |
| **11** | 1.45 | 1.39 |
| **12** | 1.41 | 1.36 |
| **13** | 1.37 | 1.33 |
| **14** | 1.34 | 1.30 |
| **15** | 1.30 | 1.27 |
| **16** | 1.28 | 1.25 |
| **17** | 1.25 | 1.22 |
| **18** | 1.23 | 1.20 |
| **19** | 1.21 | 1.18 |
| **20** | 1.19 | 1.17 |
| **21** | 1.17 | 1.15 |
| **22** | 1.15 | 1.13 |
| **23** | 1.13 | 1.12 |
| **24** | 1.12 | 1.10 |
| **25** | 1.10 | 1.09 |
| **26** | 1.09 | 1.08 |
| **27** | 1.07 | 1.07 |
| **28** | 1.06 | 1.05 |
| **29** | 1.05 | 1.04 |
| **30** | 1.04 | 1.03 |
| **31** | 1.02 | 1.02 |
| **32** | 1.01 | 1.01 |
| **33.3** | **1.00** | **1.00** |
| **34** | 0.993 | 0.994 |
| **36** | 0.975 | 0.977 |
| **38** | 0.957 | 0.961 |
| **40** | 0.941 | 0.947 |
| **42** | 0.926 | 0.933 |
| **44** | 0.912 | 0.920 |
| **46** | 0.898 | 0.908 |
| **48** | 0.886 | 0.896 |
| **50** | 0.874 | 0.885 |
| **55** | 0.846 | 0.861 |
| **60** | 0.822 | 0.838 |
| **65** | 0.800 | 0.818 |
| **70** | 0.781 | 0.800 |
| **75** | 0.763 | 0.784 |
| **80** | 0.747 | 0.769 |
| **85** | 0.732 | 0.755 |
| **90** | 0.718 | 0.742 |
| **95** | 0.705 | 0.730 |
| **100** | 0.693 | 0.719 |
| **110** | 0.672 | 0.699 |
| **120** | 0.652 | 0.681 |
| **130** | 0.635 | 0.665 |
| **140** | 0.620 | 0.650 |
| **150** | 0.606 | 0.637 |
| **160** | 0.593 | 0.625 |
| **170** | 0.581 | 0.613 |
| **180** | 0.570 | 0.603 |
| **190** | 0.560 | 0.593 |
| **200** | 0.550 | 0.584 |
| **220** | 0.533 | 0.568 |
| **240** | 0.518 | 0.553 |
| **260** | 0.504 | 0.540 |
| **280** | 0.492 | 0.528 |
| **300** | 0.481 | 0.517 |
| **320** | 0.471 | 0.507 |
| **340** | 0.461 | 0.498 |
| **360** | 0.452 | 0.490 |
| **380** | 0.444 | 0.482 |
| **400** | 0.437 | 0.475 |
| **420** | 0.430 | 0.468 |
| **440** | 0.423 | 0.461 |
| **460** | 0.417 | 0.455 |
| **480** | 0.411 | 0.449 |
| **500** | 0.405 | 0.444 |
| **550** | 0.393 | 0.431 |
| **600** | 0.382 | 0.420 |
| **650** | 0.372 | 0.410 |
| **700** | 0.362 | 0.401 |
| **750** | 0.354 | 0.393 |
| **800** | 0.347 | 0.385 |
| **850** | 0.340 | 0.378 |
| **900** | 0.333 | 0.372 |
| **950** | 0.327 | 0.366 |
| **1 000** | 0.322 | 0.360 |
| **1 050** | 0.317 | 0.355 |
| **1 100** | 0.312 | 0.350 |
| **1 150** | 0.307 | 0.346 |
| **1 200** | 0.303 | 0.341 |
| **1 250** | 0.299 | 0.337 |
| **1 300** | 0.295 | 0.333 |
| **1 400** | 0.288 | 0.326 |
| **1 500** | 0.281 | 0.319 |
| **1 600** | 0.275 | 0.313 |
| **1 700** | 0.270 | 0.307 |
| **1 800** | 0.265 | 0.302 |
| **1 900** | 0.260 | 0.297 |
| **2 000** | 0.255 | 0.293 |
| **2 100** | 0.251 | 0.289 |
| **2 200** | 0.247 | 0.285 |
| **2 300** | 0.244 | 0.281 |
| **2 400** | 0.240 | 0.277 |
| **2 500** | 0.237 | 0.274 |
| **2 600** | 0.234 | 0.271 |
| **2 700** | 0.231 | 0.268 |
| **2 800** | 0.228 | 0.265 |
| **2 900** | 0.226 | 0.262 |
| **3 000** | 0.223 | 0.259 |
| **3 200** | 0.218 | 0.254 |
| **3 400** | 0.214 | 0.250 |
| **3 600** | 0.210 | 0.245 |
| **3 800** | 0.206 | 0.242 |
| **4 000** | 0.203 | 0.238 |
| **4 200** | 0.199 | 0.234 |
| **4 400** | 0.196 | 0.231 |
| **4 600** | 0.194 | 0.228 |
| **4 800** | 0.191 | 0.225 |
| **5 000** | 0.188 | 0.222 |
| **5 200** | 0.186 | 0.220 |
| **5 400** | 0.183 | 0.217 |
| **5 600** | 0.181 | 0.215 |
| **5 800** | 0.179 | 0.213 |
| **6 000** | 0.177 | 0.211 |
| **6 200** | 0.175 | 0.209 |
| **6 400** | 0.173 | 0.207 |
| **6 600** | 0.172 | 0.205 |
| **6 800** | 0.170 | 0.203 |
| **7 000** | 0.168 | 0.201 |
| **7 200** | 0.167 | 0.199 |
| **7 400** | 0.165 | 0.198 |
| **7 600** | 0.164 | 0.196 |
| **7 800** | 0.162 | 0.195 |
| **8 000** | 0.161 | 0.193 |
| **8 500** | 0.158 | 0.190 |
| **9 000** | 0.155 | 0.186 |
| **9 500** | 0.152 | 0.183 |
| **10 000** | 0.149 | 0.181 |
| **11 000** | 0.145 | 0.176 |
| **12 000** | 0.141 | 0.171 |
| **13 000** | 0.137 | 0.167 |
| **14 000** | 0.134 | 0.163 |
| **15 000** | 0.130 | 0.160 |
| **16 000** | 0.128 | 0.157 |
| **17 000** | 0.125 | 0.154 |
| **18 000** | 0.123 | 0.151 |
| **19 000** | 0.121 | 0.149 |
| **20 000** | 0.119 | 0.147 |
| **22 000** | 0.115 | 0.143 |
| **24 000** | 0.112 | 0.139 |
| **26 000** | 0.109 | 0.136 |
| **28 000** | 0.106 | 0.133 |
| **30 000** | 0.104 | 0.130 |
| **32 000** | 0.101 | 0.127 |
| **34 000** | 0.099 | 0.125 |
| **36 000** | 0.097 | 0.123 |
| **38 000** | 0.096 | 0.121 |
| **40 000** | 0.094 | 0.119 |

## Appendix Table 13 Fatigue Life Factor $f_h$ and Fatigue Life $L \cdot L_h$

Ball Bearings $L = (C/P)^3$ $L_h = 500\ f_h^3$

Roller Bearings $L = (C/P)^{10/3}$ $L_h = 500\ f_h^{10/3}$

| C/P or $f_h$ | Ball Bearing Life | | Roller Bearing Life | |
|---|---|---|---|---|
| | L ($10^6$ rev) | $L_h$ (h) | L ($10^6$ rev) | $L_h$ (h) |
| **0.70** | 0.34 | 172 | 0.30 | 152 |
| **0.75** | 0.42 | 211 | 0.38 | 192 |
| **0.80** | 0.51 | 256 | 0.48 | 238 |
| **0.85** | 0.61 | 307 | 0.58 | 291 |
| **0.90** | 0.73 | 365 | 0.70 | 352 |
| **0.95** | 0.86 | 429 | 0.84 | 421 |
| **1.00** | **1.00** | **500** | **1.00** | **500** |
| **1.05** | 1.16 | 579 | 1.18 | 588 |
| **1.10** | 1.33 | 665 | 1.37 | 687 |
| **1.15** | 1.52 | 760 | 1.59 | 797 |
| **1.20** | 1.73 | 864 | 1.84 | 918 |
| **1.25** | 1.95 | 977 | 2.10 | 1 050 |
| **1.30** | 2.20 | 1 100 | 2.40 | 1 200 |
| **1.35** | 2.46 | 1 230 | 2.72 | 1 360 |
| **1.40** | 2.74 | 1 370 | 3.07 | 1 530 |
| **1.45** | 3.05 | 1 520 | 3.45 | 1 730 |
| **1.50** | 3.38 | 1 690 | 3.86 | 1 930 |
| **1.55** | 3.72 | 1 860 | 4.31 | 2 150 |
| **1.60** | 4.10 | 2 050 | 4.79 | 2 400 |
| **1.65** | 4.49 | 2 250 | 5.31 | 2 650 |
| **1.70** | 4.91 | 2 460 | 5.86 | 2 930 |
| **1.75** | 5.36 | 2 680 | 6.46 | 3 230 |
| **1.80** | 5.83 | 2 920 | 7.09 | 3 550 |
| **1.85** | 6.33 | 3 170 | 7.77 | 3 890 |
| **1.90** | 6.86 | 3 430 | 8.50 | 4 250 |
| **1.95** | 7.41 | 3 710 | 9.26 | 4 630 |
| **2.00** | 8.00 | 4 000 | 10.1 | 5 040 |
| **2.05** | 8.62 | 4 310 | 10.9 | 5 470 |
| **2.10** | 9.26 | 4 630 | 11.9 | 5 930 |
| **2.15** | 9.94 | 4 970 | 12.8 | 6 410 |
| **2.20** | 10.6 | 5 320 | 13.8 | 6 920 |
| **2.25** | 11.4 | 5 700 | 14.9 | 7 460 |
| **2.30** | 12.2 | 6 080 | 16.1 | 8 030 |
| **2.35** | 13.0 | 6 490 | 17.3 | 8 630 |
| **2.40** | 13.8 | 6 910 | 18.5 | 9 250 |
| **2.45** | 14.7 | 7 350 | 19.8 | 9 910 |
| **2.50** | 15.6 | 7 810 | 21.2 | 10 600 |
| **2.55** | 16.6 | 8 290 | 22.7 | 11 300 |
| **2.60** | 17.6 | 8 790 | 24.2 | 12 100 |
| **2.65** | 18.6 | 9 300 | 25.8 | 12 900 |
| **2.70** | 19.7 | 9 840 | 27.4 | 13 700 |
| **2.75** | 20.8 | 10 400 | 29.1 | 14 600 |
| **2.80** | 22.0 | 11 000 | 30.9 | 15 500 |
| **2.85** | 23.1 | 11 600 | 32.8 | 16 400 |
| **2.90** | 24.4 | 12 200 | 34.8 | 17 400 |
| **2.95** | 25.7 | 12 800 | 36.8 | 18 400 |
| **3.00** | 27.0 | 13 500 | 38.9 | 19 500 |
| **3.05** | 28.4 | 14 200 | 41.1 | 20 600 |
| **3.10** | 29.8 | 14 900 | 43.4 | 21 700 |
| **3.15** | 31.3 | 15 600 | 45.8 | 22 900 |
| **3.20** | 32.8 | 16 400 | 48.3 | 24 100 |
| **3.25** | 34.3 | 17 200 | 50.8 | 25 400 |
| **3.30** | 35.9 | 18 000 | 53.5 | 26 800 |
| **3.35** | 37.6 | 18 800 | 56.3 | 28 100 |
| **3.40** | 39.3 | 19 700 | 59.1 | 29 600 |

| C/P or $f_h$ | Ball Bearing Life | | Roller Bearing Life | |
|---|---|---|---|---|
| | L ($10^6$ rev) | $L_h$ (h) | L ($10^6$ rev) | $L_h$ (h) |
| **3.45** | 41.1 | 20 500 | 62.0 | 31 000 |
| **3.50** | 42.9 | 21 400 | 65.1 | 32 500 |
| **3.55** | 44.7 | 22 400 | 68.2 | 34 100 |
| **3.60** | 46.7 | 23 300 | 71.5 | 35 800 |
| **3.65** | 48.6 | 24 300 | 74.9 | 37 400 |
| **3.70** | 50.7 | 25 300 | 78.3 | 39 200 |
| **3.75** | 52.7 | 26 400 | 81.9 | 41 000 |
| **3.80** | 54.9 | 27 400 | 85.6 | 42 800 |
| **3.85** | 57.1 | 28 500 | 89.4 | 44 700 |
| **3.90** | 59.3 | 29 700 | 93.4 | 46 700 |
| **3.95** | 61.6 | 30 800 | 97.4 | 48 700 |
| **4.00** | 64.0 | 32 000 | 102 | 50 800 |
| **4.05** | 66.4 | 33 200 | 106 | 52 900 |
| **4.10** | 68.9 | 34 500 | 110 | 55 200 |
| **4.15** | 71.5 | 35 700 | 115 | 57 400 |
| **4.20** | 74.1 | 37 000 | 120 | 59 800 |
| **4.25** | 76.8 | 38 400 | 124 | 62 200 |
| **4.30** | 79.5 | 39 800 | 129 | 64 600 |
| **4.35** | 82.3 | 41 200 | 134 | 67 200 |
| **4.40** | 85.2 | 42 600 | 140 | 69 800 |
| **4.45** | 88.1 | 44 100 | 145 | 72 500 |
| **4.50** | 91.1 | 45 600 | 150 | 75 200 |
| **4.55** | 94.2 | 47 100 | 156 | 78 000 |
| **4.60** | 97.3 | 48 700 | 162 | 80 900 |
| **4.65** | 101 | 50 300 | 168 | 83 900 |
| **4.70** | 104 | 51 900 | 174 | 87 000 |
| **4.75** | 107 | 53 600 | 180 | 90 100 |
| **4.80** | 111 | 55 300 | 187 | 93 300 |
| **4.85** | 114 | 57 000 | 193 | 96 600 |
| **4.90** | 118 | 58 800 | 200 | 99 900 |
| **4.95** | 121 | 60 600 | 207 | 103 000 |
| **5.00** | 125 | 62 500 | 214 | 107 000 |
| **5.10** | 133 | 66 300 | 228 | 114 000 |
| **5.20** | 141 | 70 300 | 244 | 122 000 |
| **5.30** | 149 | 74 400 | 260 | 130 000 |
| **5.40** | 157 | 78 700 | 276 | 138 000 |
| **5.50** | 166 | 83 200 | 294 | 147 000 |
| **5.60** | 176 | 87 800 | 312 | 156 000 |
| **5.70** | 185 | 92 600 | 331 | 165 000 |
| **5.80** | 195 | 97 600 | 351 | 175 000 |
| **5.90** | 205 | 103 000 | 371 | 186 000 |
| **6.00** | 216 | 108 000 | 392 | 196 000 |
| **6.50** | 275 | 137 000 | 513 | 256 000 |
| **7.00** | 343 | 172 000 | 656 | 328 000 |
| **7.50** | 422 | 211 000 | 826 | 413 000 |
| **8.00** | 512 | 256 000 | 1 020 | 512 000 |
| **8.50** | 614 | 307 000 | 1 250 | 627 000 |
| **9.00** | 729 | 365 000 | 1 520 | 758 000 |
| **9.50** | 857 | 429 000 | 1 820 | 908 000 |
| **10.0** | 1 000 | – | 2 150 | – |
| **11.0** | 1 330 | – | 2 960 | – |
| **12.0** | 1 730 | – | 3 960 | – |
| **13.0** | 2 200 | – | 5 170 | – |
| **14.0** | 2 740 | – | 6 610 | – |
| **15.0** | 3 380 | – | 8 320 | – |

## Appendix Table 14 Index of Inch Design Tapered Roller Bearings

| Bearing No. CONE, CUP | Nominal Dimension (mm) d:CONE (Bore Dia.) D:CUP (Outside Dia.) | | Pages |
|---|---|---|---|
| 332 | D | 80.000 | B232, B236, B238 |
| 336 | d | 41.275 | B238 |
| 342 | d | 41.275 | B238 |
| 342 S | d | 42.875 | B238 |
| 344 | d | 40.000 | B236 |
| 344 A | d | 40.000 | B236 |
| 346 | d | 31.750 | B232 |
| 354 A | D | 85.000 | B240 |
| 359 S | d | 46.038 | B240 |
| 362 A | D | 88.900 | B240, B242 |
| 366 | d | 50.000 | B242 |
| 368 | d | 50.800 | B242 |
| 368 A | d | 50.800 | B242 |
| 369 A | d | 47.625 | B240 |
| 372 | D | 100.000 | B242 |
| 374 | D | 93.264 | B240 |
| 376 | d | 45.000 | B240 |
| 377 | d | 52.388 | B242 |
| 382 | D | 98.425 | B244 |
| 382 A | D | 96.838 | B244 |
| 382 S | D | 96.838 | B244 |
| 385 | d | 55.000 | B244 |
| 387 | d | 57.150 | B244 |
| 387A | d | 57.150 | B244 |
| 388 A | d | 57.531 | B244 |
| 390 A | d | 63.500 | B246 |
| 394 A | D | 110.000 | B246, B248 |
| 395 | d | 63.500 | B246 |
| 395 A | d | 66.675 | B248 |
| 395 S | d | 66.675 | B248 |
| 397 | d | 60.000 | B246 |
| 399 A | d | 68.262 | B248 |
| 414 | D | 88.501 | B236 |
| 418 | d | 38.100 | B236 |
| 432 | D | 95.250 | B238 |
| 432 A | D | 95.250 | B240 |
| 436 | d | 46.038 | B240 |
| 438 | d | 44.450 | B238 |
| 453 A | D | 107.950 | B240 |
| 453 X | D | 104.775 | B244 |
| 460 | d | 44.450 | B240 |
| 462 | d | 57.150 | B244 |
| 469 | d | 57.150 | B244 |
| 472 | D | 120.000 | B248, B250 |
| 472 A | D | 120.000 | B248 |
| 478 | d | 65.000 | B248 |
| 480 | d | 68.262 | B248 |
| 484 | d | 70.000 | B250 |
| 492 A | D | 133.350 | B252, B254 |
| 493 | D | 136.525 | B250, B252, B254 |
| 495 | d | 82.550 | B252 |
| 495 A | d | 76.200 | B250 |
| 495 AX | d | 76.200 | B250 |
| 496 | d | 80.962 | B252 |

| Bearing No. CONE, CUP | Nominal Dimension (mm) d:CONE (Bore Dia.) D:CUP (Outside Dia.) | | Pages |
|---|---|---|---|
| 497 | d | 85.725 | B254 |
| 498 | d | 84.138 | B254 |
| 522 | D | 101.600 | B240, B242 |
| 528 | d | 47.625 | B240 |
| 529 | d | 50.800 | B242 |
| 529 X | d | 50.800 | B242 |
| 532 X | D | 107.950 | B244 |
| 539 | d | 53.975 | B244 |
| 552 A | D | 123.825 | B244, B246, B248 |
| 553 X | D | 122.238 | B246, B248 |
| 555 S | d | 57.150 | B244 |
| 557 S | d | 53.975 | B244 |
| 558 | d | 60.325 | B246 |
| 559 | d | 63.500 | B246 |
| 560 | d | 66.675 | B248 |
| 560 S | d | 68.262 | B248 |
| 563 | D | 127.000 | B246, B248, B250 |
| 563 X | D | 127.000 | B248 |
| 565 | d | 63.500 | B246 |
| 566 | d | 69.850 | B248 |
| 567 | d | 73.025 | B250 |
| 567 A | d | 71.438 | B250 |
| 567 S | d | 71.438 | B250 |
| 568 | d | 73.817 | B250 |
| 569 | d | 64.963 | B246 |
| 570 | d | 68.262 | B248 |
| 572 | D | 139.992 | B250, B252 |
| 572 X | D | 139.700 | B252 |
| 575 | d | 76.200 | B250 |
| 580 | d | 82.550 | B252 |
| 581 | d | 80.962 | B252 |
| 582 | d | 82.550 | B252 |
| 590 A | d | 76.200 | B250 |
| 592 | D | 152.400 | B256 |
| 592 A | D | 152.400 | B250, B254, B256 |
| 593 | d | 88.900 | B254 |
| 594 | d | 95.250 | B256 |
| 596 | d | 85.725 | B254 |
| 597 | d | 93.662 | B256 |
| 598 | d | 92.075 | B256 |
| 598 A | d | 92.075 | B256 |
| 614 X | D | 115.000 | B244 |
| 622 X | d | 55.000 | B244 |
| 632 | D | 136.525 | B246, B250 |
| 633 | D | 130.175 | B246, B248, B250 |
| 637 | d | 60.325 | B246 |
| 639 | d | 63.500 | B246 |
| 643 | d | 69.850 | B248 |
| 644 | d | 71.438 | B250 |
| 645 | d | 71.438 | B250 |
| 652 | D | 152.400 | B250, B252 |
| 653 | D | 146.050 | B248, B250, B252, B254 |
| 653 X | D | 150.000 | B250 |
| 655 | d | 69.850 | B248 |

| Bearing No. BONE, CUP | Nominal Dimension (mm) d:BONE (Bore Dia.) D:CUP (Outside Dia.) | | Pages |
|---|---|---|---|
| **657** | d | 73.025 | B250 |
| **658** | d | 74.612 | B250 |
| **659** | d | 76.200 | B250 |
| **661** | d | 79.375 | B252 |
| **663** | d | 82.550 | B252 |
| **664** | d | 84.138 | B254 |
| **665** | d | 85.725 | B254 |
| **665 A** | d | 85.725 | B254 |
| **672** | D | 168.275 | B254, B256, B258 |
| **677** | d | 85.725 | B254 |
| **681** | d | 92.075 | B256 |
| **683** | d | 95.250 | B256 |
| **685** | d | 98.425 | B256 |
| **687** | d | 101.600 | B258 |
| **742** | D | 150.089 | B248, B252, B254 |
| **743** | D | 150.000 | B252 |
| **745 A** | d | 69.850 | B248 |
| **749** | d | 85.026 | B254 |
| **749 A** | d | 82.550 | B252 |
| **749 S** | d | 85.026 | B254 |
| **750** | d | 79.375 | B252 |
| **752** | D | 161.925 | B252, B254 |
| **753** | D | 168.275 | B252, B254 |
| **757** | d | 82.550 | B252 |
| **758** | d | 85.725 | B254 |
| **759** | d | 88.900 | B254 |
| **760** | d | 90.488 | B254 |
| **766** | d | 88.900 | B254 |
| **772** | D | 180.975 | B256, B258 |
| **776** | d | 95.250 | B256 |
| **779** | d | 98.425 | B256 |
| **780** | d | 101.600 | B258 |
| **782** | d | 104.775 | B258 |
| **787** | d | 104.775 | B258 |
| **792** | D | 206.375 | B260 |
| **795** | d | 120.650 | B260 |
| **797** | d | 130.000 | B260 |
| **799** | d | 128.588 | B260 |
| **799 A** | d | 130.175 | B260 |
| **832** | D | 168.275 | B252, B254 |
| **837** | d | 76.200 | B252 |
| **842** | d | 82.550 | B252 |
| **843** | d | 76.200 | B252 |
| **850** | d | 88.900 | B254 |
| **854** | D | 190.500 | B254, B256, B258 |
| **855** | d | 88.900 | B254 |
| **857** | d | 92.075 | B256 |
| **861** | d | 101.600 | B258 |
| **864** | d | 95.250 | B256 |
| **866** | d | 98.425 | B256 |
| **932** | D | 212.725 | B258 |
| **938** | d | 114.300 | B258 |
| **1220** | D | 57.150 | B228 |
| **1280** | d | 22.225 | B228 |

| Bearing No. BONE, CUP | Nominal Dimension (mm) d:BONE (Bore Dia.) D:CUP (Outside Dia.) | | Pages |
|---|---|---|---|
| **1328** | D | 52.388 | B228 |
| **1329** | D | 53.975 | B228 |
| **1380** | d | 22.225 | B228 |
| **1620** | D | 66.675 | B234 |
| **1680** | d | 33.338 | B234 |
| **1729** | D | 56.896 | B228, B230 |
| **1755** | d | 22.225 | B228 |
| **1779** | d | 23.812 | B230 |
| **1922** | D | 57.150 | B230 |
| **1988** | d | 28.575 | B230 |
| **1997 X** | d | 26.988 | B230 |
| **A2047** | d | 12.000 | B228 |
| **A2126** | D | 31.991 | B228 |
| **2523** | D | 69.850 | B232, B234 |
| **2558** | d | 30.162 | B232 |
| **2559** | d | 30.162 | B232 |
| **2580** | d | 31.750 | B232 |
| **2582** | d | 31.750 | B232 |
| **2585** | d | 33.338 | B234 |
| **2631** | D | 66.421 | B232 |
| **2690** | d | 29.367 | B232 |
| **2720** | D | 76.200 | B236 |
| **2729** | D | 76.200 | B236 |
| **2735 X** | D | 73.025 | B236 |
| **2788** | d | 38.100 | B236 |
| **2789** | d | 39.688 | B236 |
| **2820** | D | 73.025 | B234 |
| **2877** | d | 34.925 | B234 |
| **2924** | D | 85.000 | B240 |
| **2984** | d | 46.038 | B240 |
| **3120** | D | 72.626 | B232, B234 |
| **3188** | d | 31.750 | B232 |
| **3197** | d | 33.338 | B234 |
| **3320** | D | 80.167 | B236 |
| **3386** | d | 39.688 | B236 |
| **3420** | D | 79.375 | B234, B236 |
| **3478** | d | 34.925 | B234 |
| **3479** | d | 36.512 | B236 |
| **3490** | d | 38.100 | B236 |
| **3525** | D | 87.312 | B238 |
| **3576** | d | 41.275 | B238 |
| **3578** | d | 44.450 | B238 |
| **3720** | D | 93.264 | B238 |
| **3730** | D | 93.264 | B242 |
| **3775** | d | 50.800 | B242 |
| **3780** | d | 50.800 | B242 |
| **3782** | d | 44.450 | B238 |
| **3820** | D | 85.725 | B238 |
| **3877** | d | 41.275 | B238 |
| **3920** | D | 112.712 | B246, B248 |
| **3926** | D | 112.712 | B244, B246 |
| **3981** | d | 58.738 | B244 |
| **3982** | d | 63.500 | B246 |
| **3984** | d | 66.675 | B248 |

| Bearing No. CONE, CUP | Nominal Dimension (mm) d:CONE (Bore Dia.) D:CUP (Outside Dia.) | | Pages |
|---|---|---|---|
| 3994 | d | 66.675 | B248 |
| A4050 | d | 12.700 | B228 |
| A4059 | d | 15.000 | B228 |
| A4138 | D | 34.988 | B228 |
| 4335 | D | 90.488 | B238 |
| 4388 | d | 41.275 | B238 |
| 4535 | D | 104.775 | B244 |
| 4595 | d | 53.975 | B244 |
| A5069 | d | 17.455 | B228 |
| A5144 | D | 36.525 | B228 |
| 5335 | D | 103.188 | B240 |
| 5356 | d | 44.450 | B240 |
| 5535 | D | 122.238 | B244, B246 |
| 5566 | d | 55.562 | B244 |
| 5582 | d | 60.325 | B246 |
| 5584 | d | 63.500 | B246 |
| 5735 | D | 135.733 | B250, B252 |
| 5760 | d | 76.200 | B250 |
| 5795 | d | 77.788 | B252 |
| A6062 | d | 15.875 | B228 |
| A6067 | d | 16.993 | B228 |
| A6075 | d | 19.050 | B228 |
| A6157 | D | 39.992 | B228 |
| 6220 | D | 127.000 | B242, B244 |
| 6279 | d | 50.800 | B242 |
| 6280 | d | 53.975 | B244 |
| 6320 | D | 135.755 | B246, B248 |
| 6376 | d | 60.325 | B246 |
| 6379 | d | 65.088 | B248 |
| 6420 | D | 149.225 | B244, B248, B250 |
| 6454 | d | 69.850 | B248 |
| 6455 | d | 57.150 | B244 |
| 6460 | d | 73.025 | B250 |
| 6461 | d | 76.200 | B250 |
| 6535 | D | 161.925 | B250, B252, B254 |
| 6536 | D | 161.925 | B250 |
| 6559 | d | 82.550 | B252 |
| 6575 | d | 76.200 | B250 |
| 6576 | d | 76.200 | B250 |
| 6580 | d | 88.900 | B254 |
| 9121 | D | 152.400 | B246, B248 |
| 9180 | d | 61.912 | B246 |
| 9185 | d | 68.262 | B248 |
| 9220 | D | 161.925 | B250 |
| 9285 | d | 76.200 | B250 |
| 9320 | D | 177.800 | B252 |
| 9321 | D | 171.450 | B252, B254 |
| 9378 | d | 76.200 | B252 |
| 9380 | d | 76.200 | B252 |
| 9385 | d | 84.138 | B254 |
| 02420 | D | 68.262 | B230, B232 |
| 02473 | d | 25.400 | B230 |
| 02474 | d | 28.575 | B230 |
| 02475 | d | 31.750 | B232 |

| Bearing No. CONE, CUP | Nominal Dimension (mm) d:CONE (Bore Dia.) D:CUP (Outside Dia.) | | Pages |
|---|---|---|---|
| 02820 | D | 73.025 | B230, B234 |
| 02872 | d | 28.575 | B230 |
| 02878 | d | 34.925 | B234 |
| 03062 | d | 15.875 | B228 |
| 03162 | D | 41.275 | B228 |
| 05062 | d | 15.875 | B228 |
| 05068 | d | 17.462 | B228 |
| 05075 | d | 19.050 | B228 |
| 05079 | d | 19.990 | B228 |
| 05175 | D | 44.450 | B228 |
| 05185 | D | 47.000 | B228 |
| 07079 | d | 20.000 | B228 |
| 07087 | d | 22.225 | B228 |
| 07097 | d | 25.000 | B230 |
| 07098 | d | 24.981 | B230 |
| 07100 | d | 25.400 | B230 |
| 07100 SA | d | 25.400 | B230 |
| 07196 | D | 50.005 | B228, B230 |
| 07204 | D | 51.994 | B228, B230 |
| 07205 | D | 52.001 | B230 |
| 08118 | d | 30.162 | B232 |
| 08125 | d | 31.750 | B232 |
| 08231 | D | 58.738 | B232 |
| 09062 | d | 15.875 | B228 |
| 09067 | d | 19.050 | B228 |
| 09074 | d | 19.050 | B228 |
| 09078 | d | 19.050 | B228 |
| 09081 | d | 20.625 | B228 |
| 09194 | D | 49.225 | B228 |
| 09195 | D | 49.225 | B228 |
| 09196 | D | 49.225 | B228 |
| 11162 | d | 41.275 | B238 |
| 11300 | D | 76.200 | B238 |
| 11520 | D | 42.862 | B228 |
| 11590 | d | 15.875 | B228 |
| LM11710 | D | 39.878 | B228 |
| LM11749 | d | 17.462 | B228 |
| LM11910 | D | 45.237 | B228 |
| LM11949 | d | 19.050 | B228 |
| 12168 | d | 42.862 | B238 |
| 12303 | D | 76.992 | B238 |
| 12520 | D | 49.225 | B228 |
| 12580 | d | 20.638 | B228 |
| M12610 | D | 50.005 | B228 |
| M12648 | d | 22.225 | B228 |
| M12649 | d | 21.430 | B228 |
| LM12710 | D | 45.237 | B228 |
| LM12711 | D | 45.975 | B228 |
| LM12749 | d | 22.000 | B228 |
| 13175 | d | 44.450 | B238 |
| 13181 | d | 46.038 | B240 |
| 13318 | D | 80.962 | B238, B240 |
| 13620 | D | 69.012 | B236 |
| 13621 | D | 69.012 | B236 |

| Bearing No. BONE, CUP | Nominal Dimension (mm) d:BONE (Bore Dia.) D:CUP (Outside Dia.) | | Pages |
|---|---|---|---|
| 13685 | d | 38.100 | B236 |
| 13687 | d | 38.100 | B236 |
| 13830 | D | 63.500 | B236 |
| 13889 | d | 38.100 | B236 |
| 14123A | d | 31.750 | B232 |
| 14125A | d | 31.750 | B232 |
| 14130 | d | 33.338 | B234 |
| 14131 | d | 33.338 | B234 |
| 14137A | d | 34.925 | B234 |
| 14138A | d | 34.925 | B234 |
| 14139 | d | 34.976 | B234 |
| 14274 | D | 69.012 | B232, B234 |
| 14276 | D | 69.012 | B232, B234 |
| 14283 | D | 72.085 | B234 |
| 15100 | d | 25.400 | B230 |
| 15101 | d | 25.400 | B230 |
| 15106 | d | 26.988 | B230 |
| 15112 | d | 28.575 | B230 |
| 15113 | d | 28.575 | B230 |
| 15116 | d | 30.112 | B232 |
| 15117 | d | 30.000 | B232 |
| 15118 | d | 30.213 | B232 |
| 15119 | d | 30.213 | B232 |
| 15120 | d | 30.213 | B232 |
| 15123 | d | 31.750 | B232 |
| 15125 | d | 31.750 | B232 |
| 15126 | d | 31.750 | B232 |
| 15245 | D | 62.000 | B230, B232 |
| 15250 | D | 63.500 | B232 |
| 15250X | D | 63.500 | B230 |
| 15520 | D | 57.150 | B230 |
| 15523 | D | 60.325 | B230 |
| 15578 | d | 25.400 | B230 |
| 15580 | d | 26.988 | B230 |
| 16150 | d | 38.100 | B236 |
| 16284 | D | 72.238 | B236 |
| 16929 | D | 74.988 | B238 |
| 16986 | d | 43.000 | B238 |
| 17098 | d | 24.981 | B230 |
| 17118 | d | 30.000 | B232 |
| 17244 | D | 62.000 | B230, B232 |
| 17520 | D | 42.862 | B228 |
| 17580 | d | 15.875 | B228 |
| 17831 | D | 79.985 | B240 |
| 17887 | d | 45.230 | B240 |
| 18200 | d | 50.800 | B242 |
| 18337 | D | 85.725 | B242 |
| 18520 | D | 73.025 | B236 |
| 18590 | d | 41.275 | B236 |
| 18620 | D | 79.375 | B240 |
| 18690 | d | 46.038 | B240 |
| 18720 | D | 85.000 | B242 |
| 18790 | d | 50.800 | B242 |
| 19138 | d | 34.976 | B234 |

| Bearing No. BONE, CUP | Nominal Dimension (mm) d:BONE (Bore Dia.) D:CUP (Outside Dia.) | | Pages |
|---|---|---|---|
| 19150 | d | 38.100 | B236 |
| 19268 | D | 68.262 | B234, B236 |
| 21075 | d | 19.050 | B228 |
| 21212 | D | 53.975 | B228 |
| L21511 | D | 34.988 | B228 |
| L21549 | d | 15.875 | B228 |
| 22168 | d | 42.862 | B238 |
| 22325 | D | 82.550 | B238 |
| 23100 | d | 25.400 | B230 |
| 23256 | D | 65.088 | B248 |
| 23621 | D | 73.025 | B234 |
| 23691 | d | 35.000 | B234 |
| 24720 | D | 76.200 | B234 |
| 24721 | D | 76.200 | B238 |
| 24780 | d | 41.275 | B238 |
| 25520 | D | 82.931 | B238, B240 |
| 25521 | D | 83.058 | B238 |
| 25523 | D | 82.931 | B238, B240 |
| 25577 | d | 42.875 | B238 |
| 25578 | d | 42.862 | B238 |
| 25580 | d | 44.450 | B238 |
| 25584 | d | 44.983 | B240 |
| 25590 | d | 45.618 | B240 |
| 25820 | D | 73.025 | B234 |
| 25821 | D | 73.025 | B234, B236 |
| 25877 | d | 34.925 | B234 |
| 25878 | d | 34.925 | B234 |
| 25880 | d | 36.487 | B236 |
| 26118 | d | 30.000 | B232 |
| 26131 | d | 33.338 | B234 |
| 26283 | D | 72.000 | B232, B234 |
| 26820 | D | 80.167 | B238 |
| 26822 | D | 79.375 | B238 |
| 26823 | D | 76.200 | B238 |
| 26882 | d | 41.275 | B238 |
| 26884 | d | 42.875 | B238 |
| 27620 | D | 125.412 | B252 |
| 27687 | d | 82.550 | B252 |
| 27689 | d | 83.345 | B252 |
| 27690 | d | 83.345 | B252 |
| 27820 | D | 80.035 | B236 |
| 27880 | d | 38.100 | B236 |
| 28138 | d | 34.976 | B234 |
| 28315 | D | 80.000 | B234 |
| 28521 | D | 92.075 | B242 |
| 28580 | d | 50.800 | B242 |
| 28584 | d | 52.388 | B242 |
| 28622 | D | 97.630 | B244 |
| 28680 | d | 55.562 | B244 |
| 28920 | D | 101.600 | B246 |
| 28921 | D | 100.000 | B246 |
| 28985 | d | 60.325 | B246 |
| 29520 | D | 107.950 | B246 |
| 29586 | d | 63.500 | B246 |

| Bearing No. CONE, CUP | Nominal Dimension (mm) d:CONE (Bore Dia.) D:CUP (Outside Dia.) | | Pages |
|---|---|---|---|
| 29620 | D | 112.712 | B248, B250 |
| 29630 | D | 120.650 | B248 |
| 29675 | d | 69.850 | B248 |
| 29685 | d | 73.025 | B250 |
| LM 29710 | D | 65.088 | B236 |
| LM 29711 | D | 65.088 | B236 |
| LM 29748 | d | 38.100 | B236 |
| LM 29749 | d | 38.100 | B236 |
| 31520 | D | 76.200 | B234 |
| 31594 | d | 34.925 | B234 |
| 33262 | d | 66.675 | B248 |
| 33275 | d | 69.850 | B248 |
| 33281 | d | 71.438 | B250 |
| 33287 | d | 73.025 | B250 |
| JHM 33410 | D | 55.000 | B230 |
| JHM 33449 | d | 24.000 | B230 |
| 33462 | D | 117.475 | B248, B250 |
| 33821 | D | 95.250 | B242 |
| 33889 | d | 50.800 | B242 |
| 34300 | d | 76.200 | B250 |
| 34306 | d | 77.788 | B252 |
| 34478 | D | 121.442 | B250, B252 |
| 36620 | D | 193.675 | B260 |
| 36690 | d | 146.050 | B260 |
| 36920 | D | 227.012 | B262 |
| 36990 | d | 177.800 | B262 |
| 37425 | d | 107.950 | B258 |
| 37625 | D | 158.750 | B258 |
| M 38510 | D | 66.675 | B234 |
| M 38511 | D | 65.987 | B234 |
| M 38547 | d | 35.000 | B234 |
| M 38549 | d | 34.925 | B234 |
| 39236 | d | 60.000 | B246 |
| 39250 | d | 63.500 | B246 |
| 39412 | D | 104.775 | B246 |
| 39520 | D | 112.712 | B246, B248 |
| 39521 | D | 112.712 | B248 |
| 39585 | d | 63.500 | B246 |
| 39590 | d | 66.675 | B248 |
| 41100 | d | 25.400 | B230 |
| 41125 | d | 28.575 | B230 |
| 41126 | d | 28.575 | B230 |
| 41286 | D | 72.626 | B230 |
| 42350 | d | 88.900 | B254 |
| 42362 | d | 92.075 | B256 |
| 42368 | d | 93.662 | B256 |
| 42375 | d | 95.250 | B256 |
| 42376 | d | 95.250 | B256 |
| 42381 | d | 96.838 | B256 |
| 42584 | D | 148.430 | B256 |
| 42587 | D | 149.225 | B254, B256 |
| 42620 | D | 127.000 | B250, B252 |
| 42687 | d | 76.200 | B250 |
| 42688 | d | 76.200 | B250 |

| Bearing No. BONE, CUP | Nominal Dimension (mm) d:BONE (Bore Dia.) D:CUP (Outside Dia.) | | Pages |
|---|---|---|---|
| 42690 | d | 77.788 | B252 |
| 43118 | d | 30.162 | B232 |
| 43131 | d | 33.338 | B234 |
| 43300 | D | 76.200 | B232 |
| 43312 | D | 79.375 | B234 |
| 44143 | d | 36.512 | B236 |
| 44150 | d | 38.100 | B236 |
| 44157 | d | 40.000 | B236 |
| 44162 | d | 41.275 | B238 |
| 44348 | D | 88.501 | B236, B238 |
| L 44610 | D | 50.292 | B230 |
| L 44640 | d | 23.812 | B230 |
| L 44643 | d | 25.400 | B230 |
| L 44649 | d | 26.988 | B230 |
| 45220 | D | 104.775 | B244 |
| 45221 | D | 104.775 | B244 |
| 45289 | d | 57.150 | B244 |
| L 45410 | D | 50.292 | B232 |
| L 45449 | d | 29.000 | B232 |
| 46143 | d | 36.512 | B236 |
| 46162 | d | 41.275 | B238 |
| 46176 | d | 44.450 | B238 |
| 46368 | D | 93.662 | B236, B238 |
| 46720 | D | 225.425 | B260 |
| 46780 | d | 158.750 | B260 |
| 47420 | D | 120.000 | B248, B250 |
| 47487 | d | 69.850 | B248 |
| 47490 | d | 71.438 | B250 |
| 47620 | D | 133.350 | B250, B252 |
| 47680 | d | 76.200 | B250 |
| 47685 | d | 82.550 | B252 |
| 47686 | d | 82.550 | B252 |
| 47687 | d | 82.550 | B252 |
| 47820 | D | 146.050 | B256 |
| 47890 | d | 92.075 | B256 |
| 47896 | d | 95.250 | B256 |
| 48120 | D | 161.925 | B258 |
| 48190 | d | 107.950 | B258 |
| 48220 | D | 182.562 | B260 |
| 48282 | d | 120.650 | B260 |
| 48286 | d | 123.825 | B260 |
| 48290 | d | 127.000 | B260 |
| 48320 | D | 190.500 | B260 |
| 48385 | d | 133.350 | B260 |
| 48393 | d | 136.525 | B260 |
| LM 48510 | D | 65.088 | B234 |
| LM 48511 | D | 65.088 | B234 |
| LM 48548 | d | 34.925 | B234 |
| 48620 | D | 200.025 | B260 |
| 48685 | d | 142.875 | B260 |
| 49175 | d | 44.450 | B238 |
| 49176 | d | 44.450 | B238 |
| 49368 | D | 93.662 | B238 |
| 49520 | D | 101.600 | B242 |

| Bearing No. BONE, CUP | Nominal Dimension (mm) d:BONE (Bore Dia.) D:CUP (Outside Dia.) | | Pages |
|---|---|---|---|
| 49585 | d | 50.800 | B242 |
| 52387 | d | 98.425 | B256 |
| 52393 | d | 100.012 | B256 |
| 52400 | d | 101.600 | B258 |
| 52618 | D | 157.162 | B256, B258 |
| 52637 | D | 161.925 | B256, B258 |
| 53150 | d | 38.100 | B236 |
| 53162 | d | 41.275 | B238 |
| 53176 | d | 44.450 | B240 |
| 53177 | d | 44.450 | B240 |
| 53178 | d | 44.450 | B240 |
| 53375 | D | 95.250 | B236, B240 |
| 53387 | D | 98.425 | B238, B240 |
| 55175 | d | 44.450 | B240 |
| 55187 | d | 47.625 | B240 |
| 55200 | d | 50.800 | B242 |
| 55200C | d | 50.800 | B242 |
| 55206 | d | 52.388 | B242 |
| 55437 | D | 111.125 | B240, B242 |
| 55443 | D | 112.712 | B240 |
| 56418 | d | 106.362 | B258 |
| 56425 | d | 107.950 | B258 |
| 56650 | D | 165.100 | B258 |
| 59200 | d | 50.800 | B242 |
| 59429 | D | 108.966 | B242 |
| 64433 | d | 109.992 | B258 |
| 64450 | d | 114.300 | B258 |
| 64700 | D | 177.800 | B258 |
| 65200 | d | 50.800 | B242 |
| 65212 | d | 53.975 | B244 |
| 65237 | d | 60.325 | B246 |
| 65320 | D | 114.300 | B240 |
| 65385 | d | 44.450 | B240 |
| 65500 | D | 127.000 | B242, B244, B246 |
| 66187 | d | 47.625 | B240 |
| 66462 | D | 117.475 | B240 |
| 66520 | D | 122.238 | B244, B246 |
| 66584 | d | 53.975 | B244 |
| 66585 | d | 60.000 | B246 |
| 66587 | d | 57.150 | B244 |
| LM67010 | D | 59.131 | B230, B232 |
| LM67043 | d | 28.575 | B230 |
| LM67048 | d | 31.750 | B232 |
| 67320 | D | 203.200 | B260 |
| 67322 | D | 196.850 | B260 |
| 67388 | d | 127.000 | B260 |
| 67389 | d | 130.175 | B260 |
| 67390 | d | 133.350 | B260 |
| 67720 | D | 247.650 | B260, B262 |
| 67780 | d | 165.100 | B260 |
| 67787 | d | 174.625 | B262 |
| 67790 | d | 177.800 | B262 |
| 67820 | D | 266.700 | B262 |
| 67885 | d | 190.500 | B262 |

| Bearing No. BONE, CUP | Nominal Dimension (mm) d:BONE (Bore Dia.) D:CUP (Outside Dia.) | | Pages |
|---|---|---|---|
| 67920 | D | 282.575 | B262 |
| 67983 | d | 203.200 | B262 |
| 67985 | d | 206.375 | B262 |
| L68110 | D | 59.131 | B234 |
| L68111 | D | 59.975 | B234 |
| L68149 | d | 35.000 | B234 |
| 68450 | d | 114.300 | B258 |
| 68462 | d | 117.475 | B258 |
| 68709 | D | 180.000 | B258 |
| 68712 | D | 180.975 | B258 |
| JL69310 | D | 63.000 | B236 |
| JL69349 | d | 38.000 | B236 |
| 71412 | d | 104.775 | B258 |
| 71425 | d | 107.950 | B258 |
| 71437 | d | 111.125 | B258 |
| 71450 | d | 114.300 | B258 |
| 71453 | d | 115.087 | B258 |
| 71750 | D | 190.500 | B258 |
| 72187 | d | 47.625 | B240 |
| 72200 | d | 50.800 | B242 |
| 72200C | d | 50.800 | B242 |
| 72212 | d | 53.975 | B244 |
| 72212C | d | 53.975 | B244 |
| 72218 | d | 55.562 | B244 |
| 72218C | d | 55.562 | B244 |
| 72225C | d | 57.150 | B244 |
| 72487 | D | 123.825 | B240, B242, B244 |
| LM72810 | D | 47.000 | B230 |
| LM72849 | d | 22.606 | B230 |
| 74500 | d | 127.000 | B260 |
| 74525 | d | 133.350 | B260 |
| 74537 | d | 136.525 | B260 |
| 74550 | d | 139.700 | B260 |
| 74850 | D | 215.900 | B260 |
| 74856 | D | 217.488 | B260 |
| 77375 | d | 95.250 | B256 |
| 77675 | D | 171.450 | B256 |
| 78225 | d | 57.150 | B244 |
| 78250 | d | 63.500 | B246 |
| LM78310 | D | 62.000 | B234 |
| LM78310A | D | 62.000 | B234 |
| LM78349 | d | 35.000 | B234 |
| 78537 | D | 136.525 | B246 |
| 78551 | D | 140.030 | B244, B246 |
| 78571 | D | 144.983 | B244 |
| HM81610 | D | 47.000 | B228 |
| HM81649 | d | 16.000 | B228 |
| M84210 | D | 59.530 | B230 |
| M84249 | d | 25.400 | B230 |
| M84510 | D | 57.150 | B230 |
| M84548 | d | 25.400 | B230 |
| M86610 | D | 64.292 | B230, B232 |
| M86643 | d | 25.400 | B230 |
| M86647 | d | 28.575 | B230 |

| Bearing No. CONE, CUP | Nominal Dimension (mm) d:CONE (Bore Dia.) D:CUP (Outside Dia.) | | Pages |
|---|---|---|---|
| M86648A | d | 30.955 | B232 |
| M86649 | d | 30.162 | B232 |
| M88010 | D | 68.262 | B232, B234 |
| M88043 | d | 30.162 | B232 |
| M88046 | d | 31.750 | B232 |
| M88048 | d | 33.338 | B234 |
| HM88510 | D | 73.025 | B232, B234 |
| HM88542 | d | 31.750 | B232 |
| HM88547 | d | 33.338 | B234 |
| HM88610 | D | 72.233 | B230, B232, B234, B236 |
| HM88630 | d | 25.400 | B230 |
| HM88638 | d | 32.000 | B232 |
| HM88648 | d | 35.717 | B236 |
| HM88649 | d | 34.925 | B234 |
| HM89410 | D | 76.200 | B234, B236 |
| HM89411 | D | 76.200 | B234 |
| HM89443 | d | 33.338 | B234 |
| HM89444 | d | 33.338 | B234 |
| HM89446 | d | 34.925 | B234 |
| HM89446A | d | 34.925 | B234 |
| HM89449 | d | 36.512 | B236 |
| 99100 | D | 254.000 | B260 |
| 99550 | d | 139.700 | B260 |
| 99575 | d | 146.050 | B260 |
| 99587 | d | 149.225 | B260 |
| 99600 | d | 152.400 | B260 |
| LM102910 | D | 73.431 | B240 |
| LM102949 | d | 45.242 | B240 |
| JLM104910 | D | 82.000 | B242 |
| LM104911 | D | 82.550 | B242 |
| LM104911A | D | 82.550 | B242 |
| LM104912 | D | 82.931 | B242 |
| LM104947A | d | 50.000 | B242 |
| JLM104948 | d | 50.000 | B242 |
| LM104949 | d | 50.800 | B242 |
| M201011 | D | 73.025 | B236 |
| M201047 | d | 39.688 | B236 |
| JM205110 | D | 90.000 | B242 |
| JM205149 | d | 50.000 | B242 |
| JM207010 | D | 95.000 | B244 |
| JM207049 | d | 55.000 | B244 |
| JH211710 | D | 120.000 | B248 |
| JH211749 | d | 65.000 | B248 |
| HM212010 | D | 122.238 | B246, B248 |
| HM212011 | D | 122.238 | B246, B248 |
| HM212044 | d | 60.325 | B246 |
| HM212046 | d | 63.500 | B246 |
| HM212047 | d | 63.500 | B246 |
| HM212049 | d | 66.675 | B248 |
| JH217210 | D | 150.000 | B254 |
| JH217249 | d | 85.000 | B254 |
| HM218210 | D | 147.000 | B254 |
| HM218248 | d | 90.000 | B254 |
| HH221410 | D | 190.500 | B254, B256, B258 |

| Bearing No. CONE, CUP | Nominal Dimension (mm) d:CONE (Bore Dia.) D:CUP (Outside Dia.) | | Pages |
|---|---|---|---|
| HH221432 | d | 87.312 | B254 |
| HH221434 | d | 88.900 | B254 |
| HH221440 | d | 95.250 | B256 |
| HH221442 | d | 98.425 | B256 |
| HH221447 | d | 99.982 | B256 |
| HH221449 | d | 101.600 | B258 |
| HH224310 | D | 212.725 | B258 |
| HH224335 | d | 101.600 | B258 |
| HH224340 | d | 107.950 | B258 |
| HH224346 | d | 114.300 | B258 |
| M224710 | D | 174.625 | B260 |
| M224748 | d | 120.000 | B260 |
| LL225710 | D | 165.895 | B260 |
| LL225749 | d | 127.000 | B260 |
| HM231110 | D | 236.538 | B260 |
| HM231140 | d | 146.050 | B260 |
| M236810 | D | 260.350 | B262 |
| M236849 | d | 177.800 | B262 |
| LM300811 | D | 68.000 | B236 |
| LM300849 | d | 41.000 | B236 |
| L305610 | D | 80.962 | B242 |
| L305649 | d | 50.800 | B242 |
| JH307710 | D | 110.000 | B244 |
| JH307749 | d | 55.000 | B244 |
| JHM318410 | D | 155.000 | B254 |
| JHM318448 | d | 90.000 | B254 |
| L327210 | D | 177.008 | B260 |
| L327249 | d | 133.350 | B260 |
| LM328410 | D | 187.325 | B260 |
| LM328448 | d | 139.700 | B260 |
| H414210 | D | 136.525 | B248, B250 |
| H414245 | d | 68.262 | B248 |
| H414249 | d | 71.438 | B250 |
| JH415610 | D | 145.000 | B250 |
| JH415647 | d | 75.000 | B250 |
| LM501310 | D | 73.431 | B236 |
| LM501314 | D | 73.431 | B236 |
| LM501349 | d | 41.275 | B236 |
| LM503310 | D | 75.000 | B240 |
| LM503349 | d | 46.000 | B240 |
| HH506310 | D | 114.300 | B242 |
| HH506348 | d | 49.212 | B242 |
| JLM506810 | D | 90.000 | B244 |
| JLM506849 | d | 55.000 | B244 |
| JLM508710 | D | 95.000 | B246 |
| JLM508748 | d | 60.000 | B246 |
| JM511910 | D | 110.000 | B248 |
| JM511946 | d | 65.000 | B248 |
| JM515610 | D | 130.000 | B252 |
| JM515649 | d | 80.000 | B252 |
| HM516410 | D | 133.350 | B252 |
| HM516448 | d | 82.550 | B252 |
| JHM516810 | D | 140.000 | B254 |
| JHM516849 | d | 85.000 | B254 |

| Bearing No. CONE, CUP | Nominal Dimension (mm) d:CONE (Bore Dia.) D:CUP (Outside Dia.) | | Pages |
|---|---|---|---|
| HM518410 | D | 152.400 | B254 |
| HM518445 | d | 88.900 | B254 |
| LM522510 | D | 159.987 | B258 |
| LM522546 | d | 107.950 | B258 |
| LM522548 | d | 109.987 | B258 |
| LM522549 | d | 109.987 | B258 |
| JHM522610 | D | 180.000 | B258 |
| JHM522649 | d | 110.000 | B258 |
| JHM534110 | D | 230.000 | B262 |
| JHM534149 | d | 170.000 | B262 |
| LM603011 | D | 77.788 | B240 |
| LM603012 | D | 77.788 | B240 |
| LM603049 | d | 45.242 | B240 |
| L610510 | D | 94.458 | B246 |
| L610549 | d | 63.500 | B246 |
| JM612910 | D | 115.000 | B250 |
| JM612949 | d | 70.000 | B250 |
| LM613410 | D | 112.712 | B248 |
| LM613449 | d | 69.850 | B248 |
| HM617010 | D | 142.138 | B254 |
| HM617049 | d | 85.725 | B254 |
| L623110 | D | 152.400 | B258 |
| L623149 | d | 114.300 | B258 |
| JLM710910 | D | 105.000 | B248 |
| JLM710949 | d | 65.000 | B248 |
| JLM714110 | D | 115.000 | B250 |
| JLM714149 | d | 75.000 | B250 |
| JM714210 | D | 120.000 | B250 |
| JM714249 | d | 75.000 | B250 |
| H715311 | D | 136.525 | B246, B248, B250 |
| H715334 | d | 61.912 | B246 |
| H715340 | d | 65.088 | B248 |
| H715341 | d | 66.675 | B248 |
| H715343 | d | 68.262 | B248 |
| H715345 | d | 71.438 | B250 |
| JM716610 | D | 130.000 | B254 |
| JM716648 | d | 85.000 | B254 |
| JM716649 | d | 85.000 | B254 |
| JM718110 | D | 145.000 | B254 |
| JM718149 | d | 90.000 | B254 |
| JM719113 | D | 150.000 | B256 |
| JM719149 | d | 95.000 | B256 |
| JM720210 | D | 155.000 | B256 |
| JHM720210 | D | 160.000 | B256 |
| JM720249 | d | 100.000 | B256 |
| JHM720249 | d | 100.000 | B256 |
| JL724314 | D | 170.000 | B260 |
| JL724348 | d | 120.000 | B260 |
| JL725316 | D | 175.000 | B260 |
| JL725346 | d | 125.000 | B260 |
| JM734410 | D | 240.000 | B262 |
| JM734449 | d | 170.000 | B262 |
| JM738210 | D | 260.000 | B262 |
| JM738249 | d | 190.000 | B262 |

| Bearing No. CONE, CUP | Nominal Dimension (mm) d:CONE (Bore Dia.) D:CUP (Outside Dia.) | | Pages |
|---|---|---|---|
| HM801310 | D | 82.550 | B236 |
| HM801346 | d | 38.100 | B236 |
| M802011 | D | 82.550 | B238 |
| M802048 | d | 41.275 | B238 |
| HM803110 | D | 88.900 | B238 |
| HM803145 | d | 41.275 | B238 |
| HM803146 | d | 41.275 | B238 |
| HM803149 | d | 44.450 | B238 |
| M804010 | D | 88.900 | B240 |
| M804049 | d | 47.625 | B240 |
| HM804810 | D | 95.250 | B238, B240, B242 |
| HM804840 | d | 41.275 | B238 |
| HM804843 | d | 44.450 | B240 |
| HM804846 | d | 47.625 | B240 |
| HM804848 | d | 48.412 | B242 |
| HM804849 | d | 48.412 | B242 |
| HM807010 | D | 104.775 | B240, B242 |
| HM807011 | D | 104.775 | B242 |
| JHM807012 | D | 105.000 | B242 |
| HM807040 | d | 44.450 | B240 |
| HM807044 | d | 49.212 | B242 |
| JHM807045 | d | 50.000 | B242 |
| HM807046 | d | 50.800 | B242 |
| JLM813010 | D | 110.000 | B250 |
| JLM813049 | d | 70.000 | B250 |
| JLM820012 | D | 150.000 | B256 |
| JLM820048 | d | 100.000 | B256 |
| JM822010 | D | 165.000 | B258 |
| JM822049 | d | 110.000 | B258 |
| JHM840410 | D | 300.000 | B262 |
| JHM840449 | d | 200.000 | B262 |
| HM903210 | D | 95.250 | B240 |
| HM903247 | d | 44.450 | B240 |
| HM903249 | d | 44.450 | B240 |
| HM911210 | D | 130.175 | B244 |
| HM911242 | d | 53.975 | B244 |
| H913810 | D | 146.050 | B246, B248 |
| H913842 | d | 61.912 | B246 |
| H913849 | d | 69.850 | B248 |

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